

Open-Source Humanoid Robotics Landscape (Oct 2026)

Oct 2, 2026 · @julian gilyadov

Summary

As of October 2026, 161 open humanoid-robotics projects are alive — 113 active and 38 slowing — but openness is uneven. Software, simulation and models are rich and mostly permissively licensed; open hardware is small-scale; and the data that matters most (dexterous hands, whole-body motion, real-robot demos) is scarce or non-commercial.

Every layer has an open default; the thin spots are data, hands and evaluation

Layer	Default open choice	Where it is thin
Models	π 0.5 · GR00T N1.7 · SmolVLA · MolmoAct2 SONIC for humanoid whole-body control	Best frontier models are closed; no humanoid or five-finger benchmark
Training	Isaac Lab 3 · mjlabs · LeRobot · rsl_rl GMR retargeting → BeyondMimic or holosoma	Motion data mostly non-commercial; nearly every repo is G1-first
Simulation	MuJoCo / MuJoCo Warp · Newton · Isaac Sim Genesis · ManiSkill3 · RoboCasa · BEHAVIOR	Few sim-ready assets or actuator models; splat twins lack physics
Datasets	LeRobot v3 format · MCAP logs · Rerun OXE · DROID · AgiBot World · EgoSuite	Largest sets non-commercial; 81% of audited Hub datasets had issues
Data capture	GELLO · SO-101 leaders · OpenArm KER xr_teleoperate · Isaac Teleop · UMI	No open commercial glove with force; egocentric video lacks action labels
Hardware	Unitree G1 (closed) · SO-101 · OpenArm ORCA or Aero hands · moteus drivers	Open humanoids are lab-scale; open hands tested for hours, not 1M cycles

open humanoid robotics stack · 6 layers · as of Oct 2, 2026

Read across each row: the middle column is what most teams use today; the right column is where open options are thin or legally restricted.

Key findings

- **Bodies:** Unitree’s closed G1 is the de facto research humanoid, and nearly every open controller and humanoid VLA targets it. Open humanoids are lab-scale (Berkeley Humanoid Lite, ToddlerBot) or brand-new kits (Asimov, Roboto Origin), and K-Scale Labs’ Nov 2025 shutdown shows how hard open hardware is as a business.
- **Hands:** ORCA, Aero Hand Open, RUKA-v2 and AmazingHand are the live open hands. They win on modifiability and license, not durability or touch.
- **Arms:** SO-101 dominates data volume; OpenArm 2.0 and Seeed’s reBot are the new research tier with real payload.
- **Models:** openpi, GR00T and LeRobot are the hubs. Frontier labs stopped opening their best models, 2026’s open releases come mostly from Chinese companies and AI2, and GR00T N1.7 is the commercially licensed humanoid option.
- **Control:** one pipeline — retarget human motion, train a tracker in Isaac Lab or mjlab, deploy on a G1 — limited by motion-data licenses rather than algorithms.
- **Simulation:** consolidated around Newton/MuJoCo Warp and a modular Isaac Lab 3; value is moving to assets, scenes, calibration and evaluation.
- **Data and evaluation:** LeRobot v3 is the de facto format, but open data is small, noisy and mostly non-commercial; LIBERO is saturated while real-robot benchmarks score far lower.

The scoreboard below lists every active project; detailed entries follow by category, then recommended stacks and the gaps.

Activity scoreboard

161 open projects showed activity in the past year: 113 are active (commits, releases, new hardware or papers since about April 2026), 38 are slowing (last dated activity 6–12 months ago) and 10 could not be dated. Dormant and discontinued projects are listed under Stalled. Stars are GitHub counts read on Oct 2, 2026 and rounded; each table is sorted by status, then stars.

Humanoids and robot platforms

Project	What	Maintainer	License	Stars	Latest dated activity	Status
XLeRobot	dual-arm mobile robot	Rice University (Vector Wang)	Apache-2.0	5.5k	community catalog Sep 2026	Active

Project	What	Maintainer	License	Stars	Latest dated activity	Status
Open Duck Mini	small biped	Antoine Pirrone (HF-sponsored)	Apache-2.0	4.2k	Microduck launch Aug 27, 2026	Active
Unitree open stack	SDK, RL, MuJoCo, teleop, models	Unitree Robotics	BSD-3 / Apache-2.0	3.5k (rl_gym)	xr_teleoperate v1.6, Jul 29, 2026	Active
Roboto Origin	full-size humanoid kit	RoboParty	GPL-3.0 / BSD-3 / CERN-OHL-W	2.2k	open-sourced Jan 2026	Active
Reachy Mini	desktop expressive robot	Pollen Robotics / Hugging Face	Apache-2.0; HW CC BY-NC-SA	1.4k	v1.11.0, Sep 21, 2026	Active
LeKiwi	mobile base for SO-101	SIGRobotics UIUC × Hugging Face	Apache-2.0	1.4k	in LeRobot core; sim Dec 2025	Active
AgiBot Genie Sim	simulation for AgiBot robots	AgiBot	—	1.4k	Sep 7, 2026	Active
AlohaMini	dual-arm mobile robot with lift	Li Yiteng	Apache-2.0	1.1k	AlohaMini2, Jun 6, 2026	Active
Asimov v1	full-size humanoid	Menlo Research	CERN-OHL-S / GPL-2.0	~1.0k	full robot open-sourced Apr 27, 2026	Active
Tiangong / TienKung-Lab	humanoid RL, data, models	X-Humanoid (Beijing)	BSD-3	885	Sep 14, 2026	Active
HopeJR	humanoid + teleop exoskeleton	The Robot Studio × Hugging Face	Apache-2.0 (humanoid folder)	~0.8k	files Apr–May 2026; not shipped	Active
Upkie	wheeled biped	Stéphane Caron	Apache-2.0	436	v13.0.0, Oct 1, 2026	Active
OpenLoong	full-size humanoid (drawings + control)	Shanghai Humanoid Robot Innovation Center	Solderpad 2.1 ("research only")	339 (control)	driver SDK Jul 2026; dev on AtomGit	Active
Booster_gym / train	RL for T1 and K1	Booster Robotics	Apache-2.0	304	booster_train (Isaac Lab), 2026	Active

Project	What	Maintainer	License	Stars	Latest dated activity	Status
ROBOTIS AI Worker	semi-humanoid software	ROBOTIS	Apache-2.0	186	2.2.8, Sep 18, 2026	Active
Fourier GRx software	deploy code, LeRobot fork, teleop	Fourier	LGPL-3.0 / Apache-2.0	166	Aug 12, 2026	Active
Hello Robot Stretch	mobile manipulator SDK	Hello Robot	LGPL-3.0	36	Jun 10, 2026	Active
LeRobot Humanoid	QDD biped (legs)	Hugging Face	Apache-2.0	—	released May 2026	Active
Alia Humanoid	tendon-driven humanoid	Alia	—	—	Jun 2026 (walks in sim only)	Active
ToddlerBot 2.0	small humanoid	Stanford	MIT code; CC BY-NC-SA design	719	paper Jan 8, 2026	Slowing
iCub / ergoCub	research humanoid	IIT	GPL-2.0 + BSD	121	icub-models 3.2.0, Feb 26, 2026	Slowing
Reachy 2 SDK	wheeled humanoid upper body	Pollen Robotics / Hugging Face	Apache-2.0	71	1.0.15, Oct 29, 2025	Slowing
Fourier N1	partially open humanoid	Fourier	MIT docs; Apache-2.0 URDF	21	Mar 17, 2026	Slowing
Berkeley Humanoid Lite	kid-size humanoid	UC Berkeley Hybrid Robotics	MIT code; CC BY-SA CAD	—	Isaac Lab pin ≥Feb 2026; docs end Nov 2025	Slowing
BamBot	low-cost humanoid from SO arms	Tim Qian	Apache-2.0	953	not verified	Unverified
EngineAI legged_gym	RL for PM01, T800	EngineAI	—	521	not verified	Unverified
pib	3D-printed educational humanoid	pib.rocks	AGPL-3.0 (backend)	—	not verified	Unverified

Hands, grippers, tactile and hand capture

Project	What	Maintainer	License	Stars	Latest dated activity	Status
AmazingHand	4-finger servo hand	Pollen Robotics / Hugging Face	Apache-2.0; CC BY 4.0	2.4k	Apr 2026	Active
UMI	handheld capture gripper	Stanford REAL lab	MIT	1.5k	May 26, 2026	Active
Aero Hand Open	tendon hand	Chestnut Robotics (ex-TetherIA)	Apache-2.0 code; CC BY-NC-SA CAD	976	Sep 15, 2026	Active
HOMIE (OpenHomie)	exoskeleton + gloves for G1	Shanghai AI Lab + CUHK	CC BY-NC-SA (non-commercial)	619	pushed Sep 8, 2026	Active
ORCA Hand	tendon hand	ETH Zurich / ORCA Dexterity	MIT software; CC BY 4.0 hardware	597	v0.5.2, Oct 1, 2026	Active
DexUMI	hand exoskeleton capture	Stanford, Columbia et al.	MIT	266	Apr 18, 2026	Active
RUKA / RUKA-v2	tendon hand	NYU (Lerrel Pinto)	MIT (code)	199	v2 paper Mar 30, 2026	Active
9DTact	vision tactile sensor	Changyi Lin	MIT	191	Aug 21, 2026	Active
PincOpen	printable gripper	Pollen Robotics	CC BY-SA 4.0	169	Jun 16, 2026	Active
DOGlove	force-feedback glove	Tsinghua TEA Lab	MIT	140	Apr 18, 2026	Active
FastUMI-100K	handheld gripper + dataset	Shanghai AI Lab	Apache-2.0	58	Jun 8, 2026	Active
Homunculus glove	Hall-sensor teleop glove	Hugging Face	none detected	46	Sep 23, 2026	Active
AirExo-2	arm exoskeleton	SJTU	CC BY-NC-SA	43	Apr 3, 2026	Active
eFlesh	3D-printed magnetic skin	NYU	MIT	384	Oct 28, 2025	Slowing

Project	What	Maintainer	License	Stars	Latest dated activity	Status
BiDexHand	tendon + linkage hand	Northwestern	MIT	257	Nov 23, 2025	Slowing
LEAP Hand	Dynamixel hand	CMU (Deepak Pathak's lab)	non-standard (API); MIT (sim)	207 (sim)	API Oct 20, 2025	Slowing

Arms and teleoperation

Project	What	Maintainer	License	Stars	Latest dated activity	Status
SO-ARM100 / SO-101	low-cost servo arm	The Robot Studio × Hugging Face	Apache-2.0	7.6k	Sep 23, 2026	Active
reBot Arm B601	QDD desktop arm	Seed Studio	CERN-OHL-W / Apache-2.0	3.9k	launched Apr 2026; Sep 2026	Active
OpenArm	7-DoF humanoid arm	Enactic	CERN-OHL-S / Apache-2.0	3.5k	Sep 29, 2026	Active
PAROL6	stepper desktop arm	Source Robotics	GPL-3.0	3.3k	2025-26 (indirect evidence)	Active
xr_teleoperate	XR teleop for Unitree	Unitree Robotics	Apache-2.0	1.7k	v1.6, Jul 29, 2026	Active
GELLO	joint-matched teleop arms	UC Berkeley	MIT	538	v2.2.0, Aug 31, 2026	Active
NVIDIA Isaac Teleop	XR, glove and egocentric capture	NVIDIA	Apache-2.0	327	1.4.145, Sep 17, 2026	Active
SpesRobotics teleop	WebXR teleop	Spes Robotics	Apache-2.0	282	Sep 18, 2026	Active
AM-ARM200	SO-class arm upgrade	Li Yiteng	Apache-2.0	76	May 29, 2026	Active
Trossen SDK	ALOHA-lineage arm software	Trossen Robotics	—	19	Aug 25, 2026	Active
ROBOTIS OMX / OMY	Dynamixel arms	ROBOTIS	—	—	LeRobot core support, 2026	Active

Project	What	Maintainer	License	Stars	Latest dated activity	Status
AR4 MK3 / MK4	stepper arm kits	Annin Robotics	custom	—	MK4 manual Feb 2026	Active
RoArm-M3	ESP32 Wi-Fi arm	Waveshare	—	—	wiki Jul 1, 2026	Active
TWIST2	humanoid teleop → policy	Stanford + Amazon FAR	MIT	867	Dec 2, 2025	Slowing
VisionProTeleop	Vision Pro teleop	MIT Improbable AI	MIT	825	Dec 28, 2025	Slowing
Vuer	WebXR toolkit	Ge Yang	MIT	405	v0.1.6, Mar 20, 2026	Slowing
phosphobot	teleop and training app	phospho	MIT	395	Oct 22, 2025	Slowing
Arctos	printed stepper arm	Arctos Robotics	—	—	kits on sale; dev not verified	Unverified

Actuators and drivers

Project	What	Maintainer	License	Stars	Latest dated activity	Status
moteus	FOC motor controller	mjbots (Josh Pieper)	Apache-2.0	1.2k	v1.1.1, Aug 4, 2026	Active
SimpleFOC	FOC library	community	MIT	3.0k	v2.4.0 (date not verified)	Unverified
OpenQDD	printed QDD actuator	Aaed Musa	—	134	not verified	Unverified
Mini Cheetah motorcontrol	QDD firmware	Ben Katz	MIT	—	maintenance (dates not verified)	Unverified

Robot foundation models

Project	What	Maintainer	License	Stars	Latest dated activity	Status
NVIDIA Cosmos	world models	NVIDIA	OpenMDW-1.1 / Open Model License	11.7k	cosmos-rl Sep 24, 2026	Active

Project	What	Maintainer	License	Stars	Latest dated activity	Status
Isaac GR00T	humanoid VLA	NVIDIA	Apache-2.0; Open Model License (N1.7)	8.2k	N1.7 in LeRobot, Jul 7, 2026	Active
OpenDM (DM0, DM0.5)	VLA	Dexmal	Apache-2.0	2.2k	Sep 23, 2026	Active
WALL-OSS / Wall-X	VLA	X Square Robot	Apache-2.0	1.3k	Wall-X 1.1.0, Jun 2026	Active
RDT2	UMI-data VLA	Tsinghua	Apache-2.0	805	ICML 2026; paper Feb 2026	Active
MolmoAct2	fully open VLA	AI2	Apache-2.0 (data included)	782	fixes Aug 2026	Active
GalaxeaVLA (G0-G0.5)	mobile-manipulation VLA	Galaxea AI	Apache-2.0 → non-commercial from G0.5	759	G0.5, Jun 2026	Active
Xiaomi-Robotics-0	VLA	Xiaomi	Apache-2.0	641	checkpoint update Sep 2026	Active
Spirit v1.5	VLA	Spirit AI	MIT / Apache-2.0	624	fine-tuning code Apr 2026	Active
Genie Envisioner	world model + neural simulator	AgiBot	CC BY-NC-SA	586	GE-Act v2.0, Sep 10, 2026	Active
Being-H0	hand-centric VLA	BeingBeyond	MIT	59	ICML 2026	Active
SmoVLA (in LeRobot)	small VLA	Hugging Face	Apache-2.0	(LeRobot)	new checkpoints Mar-Apr 2026	Active
GigaBrain-0.7	VLA	GigaAI	Apache-2.0	—	Aug 16, 2026	Active
LingBot-VLA	VLA	Robbyant (Ant Group)	Apache-2.0	—	v2 checkpoint Jul 24, 2026	Active
OpenWAM-Alpha	world-action model	OpenWAM	Apache-2.0	—	Sep 2026	Active

Project	What	Maintainer	License	Stars	Latest dated activity	Status
openpi (π0, π0-FAST, π0.5)	generalist VLA	Physical Intelligence	Apache-2.0; Gemma terms	13.2k	last open weights Sep 2025; issues Jul 2026	Slowing
V-JEPA 2 / 2.1	video world model	Meta FAIR	MIT / Apache-2.0	4.7k	2.1, Mar 16, 2026	Slowing
AgiBot World / GO-1	VLA + dataset	AgiBot + OpenDriveLab	CC BY-NC-SA	3.2k	GO-1 Sep 2025; challenge Jun 2026	Slowing
VLA-Adapter	small-backbone VLA	OpenHelix	MIT	2.3k	Mar 2026	Slowing
DP3 (3D Diffusion Policy)	point-cloud policy	Yanjie Ze	MIT	1.4k	Oct 2025	Slowing
UnifoLM-WMA-0	world-action model	Unitree Robotics	—	1.1k	Sep 2025	Slowing
RoboBrain 2.5	embodied reasoning model	BAAI	Apache-2.0	1.1k	Jan 2026	Slowing
RynnVLA-002	VLA + world model	Alibaba DAMO	Apache-2.0	1.1k	Nov 10, 2025	Slowing
X-VLA	cross-embodiment VLA	Tsinghua AIR + Shanghai AI Lab	Apache-2.0	728	Mar 2, 2026	Slowing
UnifoLM-VLA-0	humanoid VLA	Unitree Robotics	—	546	Jan 29, 2026	Slowing
InternVLA-M1 / A1	VLAs	Shanghai AI Lab	MIT / CC BY-NC-SA	432	Mar 27, 2026	Slowing
EO-1	reasoning + action VLA	Shanghai AI Lab	MIT	291	moved Nov 2025	Slowing
DreamZero	world-action model	NVIDIA GEAR	CC BY-NC 4.0	—	Mar 15, 2026	Slowing

Whole-body control and model-based control

Project	What	Maintainer	License	Stars	Latest dated activity	Status
Drake	model-based toolbox + sim	Toyota Research Institute	BSD-3	4.2k	1.57.0, Sep 10, 2026	Active
Pinocchio	rigid-body dynamics	Inria + LAAS-CNRS	BSD-2	3.8k	4.1.0, Jul 8, 2026	Active
mjlab	RL framework on MuJoCo Warp	UC Berkeley (mujocolab)	Apache-2.0	3.1k	1.6.0, Aug 9, 2026	Active
GR00T-WBC / SONIC	humanoid tracker + teleop	NVIDIA GEAR	Apache-2.0 + Open Model License	~3k	SONIC v1.1, Jul 23, 2026	Active
rsl_rl	RL library	ETH RSL	BSD-3	~3k	5.5.1, Sep 9, 2026	Active
ProtoMotions3	humanoid sim/learning framework	NVIDIA Research	Apache-2.0	~2.4k	2026 (Newton 1.0, Kimodo)	Active
holosoma	humanoid sim2real stack	Amazon FAR	Apache-2.0	1.7k	issues active 2026	Active
Crocoddyl	optimal control	LAAS-CNRS	BSD-3	1.3k	3.2.1, May 10, 2026	Active
unitree_rl_lab	vendor RL (Isaac Lab)	Unitree Robotics	Apache-2.0	1.3k	Isaac Lab 2.3-era	Active
Pink	differential IK	Stéphane Caron	Apache-2.0	851	4.4.0, Sep 9, 2026	Active
BFM-Zero	behavior foundation model	CMU LeCAR + Meta	CC BY-NC 4.0	715	ICLR 2026	Active
Humanoid-GPT	GPT-style tracker	Galbot	Apache-2.0	457	Jun 2026	Active
PlaCo	IK/ID + walking	Rhoban	MIT	353	0.10.1, Sep 28, 2026	Active
TSID	inverse dynamics	LAAS-CNRS	BSD-2	349	1.10.0, Apr 14, 2026	Active
WBC-AGILE	Isaac Lab 3 workflow	NVIDIA Isaac	Apache-2.0	346	Jun 2026+	Active

Project	What	Maintainer	License	Stars	Latest dated activity	Status
Aligator	trajectory optimization	Inria	BSD-2	317	v0.19.0, Apr 2026	Active
EgoHumanoid	egocentric → humanoid policy	OpenDriveLab	Apache-2.0	218	RSS 2026	Active
BeyondMimic	per-motion tracker	UC Berkeley + Stanford	MIT (deploy)	2.4k	paper v4 Nov 2025	Slowing
GMR	motion retargeting	Stanford (Yanjie Ze)	MIT	2.4k	Jan 21, 2026	Slowing
MimicKit	motion-imitation algorithms	Xue Bin Peng	Apache-2.0	2.3k	Jan 2026	Slowing
robot_lab	Isaac Lab humanoid extension	Ziqi Fan	Apache-2.0	1.9k	v2.3.2, Feb 2026	Slowing
LocoMuJoCo	imitation benchmark	TU Darmstadt	MIT	1.5k	v1.1.0, Mar 2026	Slowing
mink	MuJoCo IK	Kevin Zakka	Apache-2.0	1.5k	v1.1.0, Feb 2026	Slowing
PBHC (KungfuBot)	video → dynamic skills	China Telecom TeleAI	CC BY-NC 4.0	1.1k	Oct 2025	Slowing
VideoMimic	video → humanoid policy	UC Berkeley	MIT	831	Sep 30, 2025	Slowing
HDMI	video → interaction skills	CMU LeCAR	—	664	2025	Slowing
FALCON	force-adaptive loco-manipulation	CMU LeCAR	MIT	435	L4DC 2026	Slowing
MuJoCo MPC	predictive control	Google DeepMind	Apache-2.0	1.7k	not verified	Unverified
OCS2	MPC toolbox	ETH RSL	BSD-3	1.5k	not verified	Unverified
IHMC Open Robotics Software	whole-body control (Java)	IHMC	Apache-2.0	325	not verified	Unverified

Simulators and environments

Project	What	Maintainer	License	Stars	Latest dated activity	Status
Genesis World	multiphysics simulator	Genesis AI	Apache-2.0	~30k	1.4.3, Sep 30, 2026	Active
MuJoCo	physics engine	Google DeepMind	Apache-2.0	15k	3.14.0, Sep 22, 2026	Active
Isaac Lab	robot-learning framework	NVIDIA	BSD-3	8.2k	v3.0.0-EA, Sep 16, 2026	Active
Infinigen	procedural scenes and assets	Princeton VL	BSD-3	7.1k	v2.0.0a1, Jul 15, 2026	Active
NVIDIA Warp	GPU simulation framework	NVIDIA	Apache-2.0	6.9k	1.17.0, Aug 31, 2026	Active
Newton	GPU physics engine	Linux Foundation	Apache-2.0	5.6k	1.6.0, Sep 10, 2026	Active
MuJoCo Menagerie	curated robot models	Google DeepMind	per model	4.1k	pip release Sep 28, 2026	Active
Isaac Sim	simulator	NVIDIA	Apache-2.0 + proprietary Kit	~4.0k	6.1.0, Sep 9, 2026	Active
ManiSkill3	GPU manipulation sim	UCSD + Hillbot	Apache-2.0	3.3k	3.0.1, Apr 21, 2026	Active
Brax	JAX RL training (physics deprecated)	Google	Apache-2.0	3.2k	pushed Sep 29, 2026	Active
Project Chrono	multiphysics engine	UW-Madison	BSD-3	3.1k	10.0.0, Mar 27, 2026	Active
RoboTwin 2.0	bimanual benchmark + data generator	RoboTwin team	MIT	2.8k	Aug 3, 2026	Active
robosuite	MuJoCo manipulation framework	UT Austin (ARISE)	MIT	2.6k	pushed Jul 11, 2026	Active
RoboVerse	one API over many simulators	academic consortium	Apache-2.0	1.9k	1.0.0b0, May 31, 2026	Active
Gymnasium-Robotics	MuJoCo environments	Farama Foundation	MIT	1.9k	pushed Sep 7, 2026	Active

Project	What	Maintainer	License	Stars	Latest dated activity	Status
BEHAVIOR-1K / OmniGibson	household benchmark on Isaac Sim	Stanford	MIT	1.7k	pushed Sep 29, 2026	Active
RoboCasa365	kitchen sim benchmark	UT Austin	MIT; assets CC BY 4.0	1.5k	annotations Jul 7, 2026	Active
MuJoCo Warp	GPU MuJoCo	Google DeepMind + NVIDIA	Apache-2.0	~1.4k	3.14.0, Sep 22, 2026	Active
Gazebo (gz-sim)	ROS simulator	Open Robotics / Intrinsic	Apache-2.0	1.4k	Jetty LTS (2025)	Active
Isaac Lab-Arena	environment authoring + evaluation	NVIDIA	Apache-2.0	557	v0.3 alpha, 2026	Active
Webots	desktop simulator	Cyberbotics	Apache-2.0	4.5k	R2025a, Feb 2025	Slowing
MuJoCo Playground	GPU environment suite	Google DeepMind + UC Berkeley	Apache-2.0	2.2k	0.2.0, Mar 16, 2026	Slowing
SAPIEN	physics + rendering engine	UCSD	MIT	793	3.0.3, Mar 10, 2026	Slowing

Middleware and tooling

Project	What	Maintainer	License	Stars	Latest dated activity	Status
LeRobot	learning library + dataset format	Hugging Face	Apache-2.0	27.8k	v0.6.1, Aug 3, 2026	Active
Rerun	logging + visualization	Rerun	MIT / Apache-2.0	11k	0.38.1, Sep 16, 2026	Active
dora-rs	dataflow runtime	dora-rs community	Apache-2.0	3.9k	1.0.1, Sep 3, 2026	Active
Zenoh	pub/sub transport	Eclipse / ZettaScale	EPL-2.0 / Apache-2.0	3.0k	1.10.1, Sep 7, 2026	Active

Project	What	Maintainer	License	Stars	Latest dated activity	Status
Viser	web 3D visualization	viser-project	MIT	2.7k	1.1.1, Sep 15, 2026	Active
MoveIt 2	motion planning	PickNik (being acquired by Qualcomm)	BSD-3	~2.0k	binaries for Lyrical, 2026	Active
Copper-rs	deterministic Rust runtime	Copper Robotics	Apache-2.0	1.5k	1.2.2, Oct 2, 2026	Active
MCAP	log format	Foxglove	MIT	1.1k	Python 1.5.0, Sep 24, 2026	Active
Lichtblick	open Foxglove Studio fork	BMW-led	MPL-2.0	1.1k	1.29.1, Sep 8, 2026	Active
any4lerobot	dataset converters	community	MIT	1.1k	v3.0 support (2025–26)	Active
ros2_control	controller framework	ros-controls	Apache-2.0	935	Lyrical branch, 2026	Active
robot_descriptions.py	robot model index	Stéphane Caron	Apache-2.0	833	3.2.0, Sep 12, 2026	Active
rmw_zenoh	ROS 2 middleware	ROS 2 / ZettaScale	Apache-2.0	497	Tier 1 since Kilted	Active
Isaac ROS	GPU ROS 2 packages	NVIDIA	Apache-2.0	319	5.0.0, Sep 21, 2026	Active
ROS 2	robot middleware	Open Robotics	Apache-2.0	—	Lyrical Luth, May 22, 2026	Active

Full humanoid platforms (open hardware)

Open humanoid hardware is real but small-scale. The credible 2025–26 designs are lab robots under \$6k plus a few full-size kits from Singapore and China. The one venture-backed Western open-humanoid company, K-Scale Labs, shut down in November 2025 (see Stalled).

Robot	Height	Weight	DoF	Price or BOM	Actuators
Berkeley Humanoid Lite	0.8 m	16 kg	22	under \$5k	open, 3D-printed cycloidal
ToddlerBot 2.0	0.56 m	3.4 kg	30	under \$6k (motor bundle \$4.3k)	Dynamixel servos
Asimov v1	1.2 m	35 kg	25 + 2 passive	~\$15k kit target	Encos QDD
Roboto Origin	1.25 m	34 kg	23	~\$7k BOM (¥49.7k)	Damiao QDD
LeRobot Humanoid (legs only)	—	—	12	\$2.6k BOM	Robstride QDD
HopeJR	full-size	—	66 (claimed)	~\$3k target, not shipped	Feetech servos, Robstride legs
OpenLoong Qinglong	~1.85 m	80 kg	43	not public	QDD over EtherCAT
Tiangong 3.0	1.69 m	62 kg	43	not public	—
Fourier N1	1.3 m	38 kg	—	not public	—
iCub	~1 m	~22 kg	~53	~€250k	—
Reachy 2 (wheeled upper body)	1.36-1.66 m	up to 50 kg	7 per arm	~\$70k at 2024 launch (unverified)	Orbita parallel joints

Berkeley Humanoid Lite

UC Berkeley's printable kid-size humanoid: the cheapest research-grade design whose actuators are open too. [Site](#) · [paper](#)

- **Who:** Hybrid Robotics lab under Koushil Sreenath; lead authors Yufeng Chi and Qiayuan Liao (RSS 2025).
- **Design:** Modular 15:1 cycloidal actuators built on drone motors and printed in PLA on a desktop printer; an Intel N95 mini PC; SteamVR teleop. URDF, MJCF and USD all export from one Onshape model; training runs in Isaac Lab with MuJoCo sim2sim.
- **Evidence:** Gearboxes run ~90% efficient and track torque within 0.5 N·m. A 60-hour endurance run showed stable efficiency but slowly growing backlash. Walking transfers zero-shot from sim; demos include writing and solving a Rubik's cube.
- **Trade-offs:** Best for a lab that wants to own every part. Plastic gears wear and payload is low; ToddlerBot is sturdier and cheaper to repair.

ToddlerBot 2.0

Stanford's "ML-first" toddler-size humanoid, built for fast sim-to-real iteration. [Site](#) · [paper](#)

- **Who:** Haochen Shi (lead), with Shuran Song and C. Karen Liu (CoRL 2025).
- **Design:** Dynamixel servos, a Jetson Orin NX and a 200 Hz C++ control loop. Version 2.0 (Aug 2025) added cartwheels and crawling via DeepMimic, Quest VR teleop, stereo depth, MJX training and a rewritten Onshape-to-MJCF pipeline. A Jan 2026 paper extended it to non-foot locomotion.
- **Evidence:** An independent group rebuilt it from the docs. The maintainers say cartwheel success is "still low" but the robot "almost never breaks".
- **Trade-offs:** The best-documented small humanoid and native to MuJoCo/MJX. Servo dynamics limit agility, and the design files are non-commercial (CC BY-NC-SA 4.0).

Asimov v1 (Menlo Research)

A full-size, fully open humanoid from Singapore with real QDD actuators. [Site](#)

- **Who:** Menlo Research Pte. Ltd. The legs were open-sourced Jan 27, 2026 and the full robot Apr 27, 2026.
- **Design:** 120 N·m peak joints, parallel ankles, a Multi Jet Fusion printed structure, Raspberry Pi 5 plus Radxa CM5 compute. The release includes CAD, schematics, PCBs, a MuJoCo model and an mlab training repo.
- **Evidence:** The README still lists the locomotion policy, API and app as "pending". The knee survives a ~40 kg quasi-static push (self-reported).
- **Trade-offs:** The most complete Western full-size open design. The leg actuators alone cost ~\$8.5k, no walking policy is released yet, and copyleft licenses (CERN-OHL-S, GPL-2.0) deter some companies.

Roboto Origin (RoboParty)

A Chinese "full-stack" open humanoid kit at roughly half a Unitree G1's price.

- **Who:** RoboParty, founded Feb 2025 by Yi Huang; \$10M seed from MPCi, Xiaomi and Galbot. Open-sourced Jan 2026.
- **Design:** Damiao QDD actuators, a CNC aluminium frame, D-Robotics RDK X5 compute and a 48 V battery. Isaac Lab RL with an AMP-style gait, ROS 2 Humble and XR teleop. The BOM links every part to a Taobao listing.
- **Evidence:** Claims ~3 m/s running (self-reported); about 100 kit pre-orders by Feb 2026.

- **Trade-offs:** The most reproducible supply chain of any open humanoid. The community is Chinese-first (QQ groups), most modules are GPL-3.0, and the actuators are closed.

LeRobot Humanoid (Hugging Face)

Hugging Face's open QDD biped from May 2026, the cheapest legged platform in this list.

- **Who:** Virgile Batto (built at Hugging Face LeRobot), with Haixuan Xavier Tao of dora-rs.
- **Design:** Robstride motors (~\$1,880 of the BOM), 75 printed parts and a Raspberry Pi 5. The upper body is out of scope for now. Apache-2.0 throughout.
- **Notable:** It ships a system-identification repo that replays logs in MuJoCo-Warp and fits simulator parameters with CMA-ES — a reusable answer to sim-to-real on cheap hardware.
- **Trade-offs:** Very new; no walking benchmarks yet.

HopeJR (Hugging Face × The Robot Studio)

A full-size humanoid paired with its own teleop exoskeleton; announced, not yet shipped.

- **Who:** Rob Knight (The Robot Studio, design) and Martino Russi (Hugging Face, arm, exoskeleton and LeRobot work). Announced May 29, 2025 for delivery "by end of 2025".
- **Design:** Feetech-servo arms with tendon-driven hands; Robstride series-elastic legs (files uploaded Apr 2026); a no-solder "Homunculus" exoskeleton and glove with a Hall sensor on every joint.
- **Evidence:** No shipping evidence found as of Oct 2026, but LeRobot already ships hope_jr and homunculus drivers.
- **Trade-offs:** The only open, low-cost design that pairs a humanoid with a data-collection exoskeleton. Product viability is unproven, and the repo root has no license file (the humanoid folder is Apache-2.0).

OpenLoong / Qinglong

China's state-backed full-size open reference humanoid.

- **Who:** Shanghai Humanoid Robot Innovation Center, hosted by the OpenAtom Foundation; unveiled at WAIC in Jul 2024.
- **Design:** Up to 400 TOPS compute, ≥20 kg payload and ≥3 h battery (self-reported). The open files are mostly 2D PDF part drawings, not parametric CAD. MPC+WBC control code and a Unity RL playground are public.

- **Trade-offs:** A complete full-size reference, but heavy and drawing-based. The Solderpad license is undercut by a "research purposes only" note, and development moved to AtomGit, so the GitHub repos are mirrors.

Tiangong / Tien Kung (X-Humanoid)

Beijing's state-backed humanoid program: open software, closed hardware.

- **Who:** Beijing Humanoid Robot Innovation Center (X-Humanoid); \$100M financing reported Feb 2026; Tiangong 3.0 launched Feb 10, 2026.
- **What's open:** TienKung-Lab (Isaac Lab locomotion with AMP and GMR retargeting, updated Sep 2026), deployment code, URDF, the RoboMIND dataset, the Pelican-VL model and the XR-1 VLA. No hardware CAD was found despite claims of open "blueprints".
- **Evidence:** A Tiangong robot won the first humanoid half-marathon (Apr 2025).
- **Trade-offs:** A good source of locomotion code and data; not buildable.

Fourier N1

A partially open humanoid from Fourier (Shanghai), launched Apr 2025.

- **What's open:** BOM, structural drawings, assembly guide and base control software (per Yicai); an Apache-2.0 URDF and a MuJoCo Menagerie model. The hardware files' license and location are unverified.
- **Evidence:** Claims 3.5 m/s running (self-reported). The docs repo was last updated Mar 2026.
- **Trade-offs:** Good sim models, but thin open tooling compared with Unitree's.

iCub / ergoCub (IIT)

The canonical open research humanoid, maintained by the Italian Institute of Technology for two decades.

- **Design:** YARP middleware, Gazebo, conda-forge packages and a rich tactile skin; ergoCub is the newer, ergonomics-focused sibling. icub-models 3.2.0 shipped Feb 26, 2026.
- **Trade-offs:** Deep whole-body-control and tactile heritage. Expensive, built in small numbers, and poorly matched to today's RL and VLA tooling.

Reachy 2 (Pollen Robotics / Hugging Face)

A wheeled, bimanual humanoid upper body with turnkey VR teleop.

- **Who:** Pollen Robotics (Bordeaux), acquired by Hugging Face in Apr 2025.
- **Design:** Arms with ~3 kg payload each, an omni base with LiDAR, stereo and RGB-D cameras, ROS 2 Humble and a Python SDK; LeRobot support since Sep 2025.
- **Trade-offs:** Polished and ready for data collection, but expensive with a small dataset community. The SDK has been quiet since Nov 2025.

Small and expressive robots

Hugging Face’s robots with real sales volume are small and expressive, not full humanoids.

- [Reachy Mini](#): a 28 cm desktop robot, \$399 tethered or \$499 wireless. Over 10,000 units had shipped by late Aug 2026 (secondary source), with 60+ apps on HF Spaces. Software is Apache-2.0; the hardware files are non-commercial.
- [Open Duck Mini v2](#): a ~42 cm, under-\$400 bipedal duck inspired by Disney’s BDX, led by Antoine Pirrone. Its commercial cousin **Microduck** (\$399, pre-orders from Aug 27, 2026) drew headlines claiming 10,000+ sales within days, which could not be verified. Microduck’s software is Apache-2.0 and its gait trains in 1–2 h on one GPU in mjlab (self-reported), but its hardware is closed.
- [Upkie](#): Stéphane Caron’s open wheeled biped on mjbots actuators; v13.0 shipped Oct 1, 2026.
- **Also active:** [pib](#) (3D-printed educational humanoid), [Alia](#) (tendon-driven, walking only in sim so far) and [HumanaOpen](#) (a LeRobot semi-humanoid). InMoov lives on as a hobbyist design.

Closed-hardware humanoids with open software

Unitree’s closed robots running Unitree’s open software are the de facto research humanoid. Unitree says it shipped 5,500+ humanoids in 2025, mostly to education and research, and nearly every open control or VLA project in this doc supports the G1.

Robot	Height	Weight	DoF	Price
Unitree G1	1.32 m	~35 kg	23 (EDU 23–43)	from \$13.5k

Robot	Height	Weight	DoF	Price
Unitree R1	1.23 m	27–29 kg	20–26	\$4.9k–\$5.9k
Unitree H2	1.82 m	~70 kg	31	\$29.9k
Booster K1	~0.95 m	19.5 kg	22	from \$5,999
Booster T1	1.18 m	~30 kg	23–41	quote only
Booster T2	~1.4 m	42–43 kg	31	quote only
1X NEO (closed reference)	1.68 m	30 kg	22 per hand	~\$20k or \$499/month (Oct 2025 reports)

Unitree (G1, R1, H2)

The default body for humanoid research, with the deepest open software stack of any vendor.

- **Who:** Unitree Robotics (Hangzhou), led by founder Wang Xingxing. It debuted on Shanghai's STAR Market in mid-August 2026, raising ¥6.1B (~\$905M), and closed its first day up ~460%. 2025 revenue was reportedly ¥1.70B (+335%).
- **Open software:** [unitree_sdk2](#) (DDS) and ROS 1/2 drivers; [unitree_mujoco](#); RL training in [unitree_rl_gym](#) (Isaac Gym → MuJoCo sim2sim → real) and [unitree_rl_lab](#) (Isaac Lab 2.3); [xr_teleoperate](#) for Vision Pro, PICO and Quest (v1.6 on Jul 29, 2026 added H2, R1 and BrainCo hands); a LeRobot fork for imitation learning; and two model releases, [UnifoLM-WMA-0](#) (Sep 2025) and [UnifoLM-VLA-0](#) (Jan 2026).
- **Adoption:** More than 6,500 humanoids produced in 2025 (self-reported). GR00T, BeyondMimic, GMR, HOMIE and most motion-tracking work target the G1, and MuJoCo Menagerie carries its models.
- **Trade-offs:** Unbeatable price-performance and community, so it is the first embodiment any data or simulation product should support. Actuators and firmware are closed, low-level control reportedly needs EDU units, and a Bluetooth vulnerability ("UniPwn") was disclosed in Sep 2025.

Booster Robotics (T1, K1, T2)

The strongest closed-hardware alternative to Unitree for soccer and kid-size research.

- **Who:** Booster Robotics (Beijing).
- **Open software:** [booster_gym](#) (Isaac Gym training, MuJoCo cross-sim, Webots checks), now succeeded by `booster_train` (Isaac Lab), `booster_deploy` and `booster_assets` with K1 support. The T1 model is in MuJoCo Menagerie.
- **Adoption:** T1 was the RoboCup 2025 AdultSize champion platform and K1 the KidSize champion (secondary source).
- **Trade-offs:** Good hardware for the price, but a far smaller ecosystem than Unitree's.

Fourier (GR-1, GR-2, GR-3)

Shanghai's Fourier publishes deployment code, a LeRobot fork, teleop and MuJoCo models ([FFTAI](#)), mostly under LGPL-3.0 or Apache-2.0; the GR-1 URDF is GPL-3.0. The open software is thin next to Unitree's. Its N1 is covered under open hardware above.

AgiBot, Galaxea, EngineAI, HighTorque, LimX, PNDbotics

These Chinese vendors open-source software and robot descriptions, but none has released open humanoid hardware since AgiBot's 2024 X1.

- **AgiBot:** [genie_sim](#) (updated Sep 2026), Genie Envisioner and ACoT-VLA. The X2 humanoid is SDK-only.
- **Galaxea:** the [GalaxeaVLA](#) G0 model family and an Apache-2.0 URDF of the R1 Pro.
- **EngineAI:** [engineai_legged_gym](#) and an Isaac Lab port for its PM01 and T800.
- **HighTorque:** a BeyondMimic port for the Mini Pi Plus; its only open CAD is the MIT-licensed Panthera-HT arm.
- **LimX and PNDbotics:** Apache-2.0 and MIT robot descriptions (Oli, TRON, Adam Lite).

ROBOTIS AI Worker

A wheeled, bimanual semi-humanoid (19–25 DoF) built on ROS 2 and LeRobot. The [software](#) is Apache-2.0; version 2.2.8 (Sep 18, 2026) added MuJoCo models. The hardware is a closed commercial product.

Hello Robot Stretch

Not a humanoid, but a common open-software mobile manipulator for home research. Stretch 4 sells for \$29,950; its body library is LGPL-3.0 and a Stretch 3 model is in MuJoCo Menagerie.

Closed reference points

1X NEO targets homes with a 4-hour battery and remote "Expert Mode" teleoperation. Figure 03, Tesla Optimus, Agility Digit and Apptronik Apollo publish no list prices; Apollo has a Menagerie model. None of their software is open.

Dexterous hands

Four open hands have real 2026 momentum — ORCA, Aero Hand Open, RUKA-v2 and Hugging Face's AmazingHand/HOPEJr — while LEAP remains the most-simulated baseline but has slowed. Open hands now win on hackability and licensing, not price or durability: closed hands claim hundreds of thousands to millions of cycles, open ones report hours.

Hand	Fingers; DoF / actuated	Actuation	Weight	Force or payload	Durability evidence	Touch sensing
LEAP v1	4; 16/16	direct servo (Dynamixel)	595 g	19.5 N pull-out; 4.0 kg	1 h holding 2 kg on a fingertip	none
LEAP v2 Advanced	—; 21 joints / 17 motors	servo + tendon, powered palm	—	—	—	none
ORCA v2	5 + wrist; 17/17	tendon	1.1–1.25 kg	—	7 h 17 autonomous (~2k grasps, v1); 5 h, ~3.5k cycles (v2)	351 Hall taxels (option)
RUKA-v2	5 + 2-DoF wrist; 20/16	tendon	—	6 kg payload, 2.74 N pinch (v1)	20 h continuous (v1); 5 h thermal (v2)	eFlesh fingertips (option)
Aero Hand Open	5; 16 joints / 7	tendon, coupled	374–389 g	10–12 N fingertip	>400k cycles (self-reported)	motor encoders only
AmazingHand	4; 8/8	micro-servo, parallel	~400 g	—	—	none

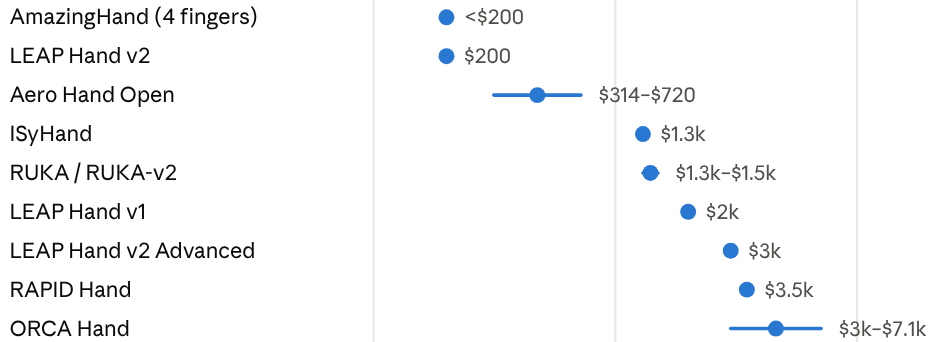
Hand	Fingers; DoF / actuated	Actuation	Weight	Force or payload	Durability evidence	Touch sensing
HOPEJr hand	5; 16 servos	tendon	—	—	—	Hall-sensor glove for teleop
BiDexHand	5; 21/16	tendon + linkage	—	2.14 N; lifts 4.54 kg	—	none
RAPID Hand	5; 20/20	Dynamixel + linkage	1.15 kg	7 N	—	480 taxels + wrist RGB- D
Sharpa Wave (closed)	5; 22/22	direct drive	0.8 kg	20 N; 40 kg	1M–2.5M cycles (self-reported)	>1,000 taxels per fingertip
Allegro V4/V5 (closed)	4; 16/16	direct drive	—	8.5 N (LEAP's test)	began failing after 15 min (LEAP's test)	optional
Inspire RH56DFX (closed)	5; 12 joints / 6	linkage	0.54 kg	—	—	force and position
Unitree Dex5-1 (closed)	5; 20/16	—	1.1 kg	10 N; 3.5–4.5 kg	—	94 taxels (P variant)
Wuji (closed)	5; 20/20	direct drive	—	~15 N (aggregator)	~40 min thermal (RUKA-v2's test)	none

Prices are charted below; aggregator and paper prices often disagree, so ranges are shown.

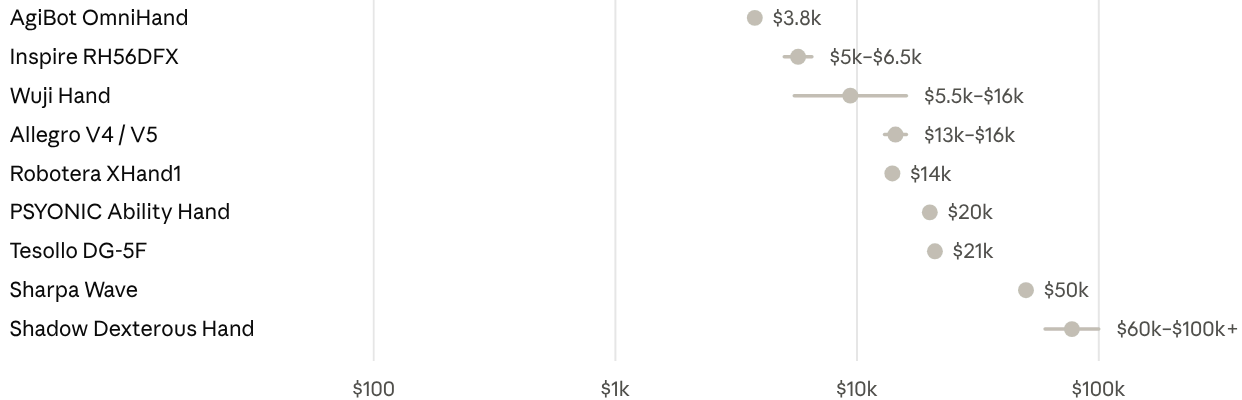
Open hands cost \$200–\$7k; closed hands run from \$3.8k to \$100k+

USD per hand, log scale · open = parts or kit · closed = list or quote · lines span variants or sources

Open designs (parts or kit)



Closed products (list or quoted price)



vendor pages, distributors, aggregators and papers, compiled Oct 2, 2026 · 18 hands

Open designs cluster under ~\$3.5k in parts, but an assembled open hand (ORCA tops out near \$7.1k with touch sensing) now overlaps mid-price closed hands such as AgiBot's OmniHand and Inspire's RH56.

LEAP Hand (v1, v2, v2 Advanced)

CMU's Dynamixel hand, still the most-simulated research baseline. [Site](#) · [v1 paper](#)

- **Who:** Kenneth Shaw (CMU PhD student, designer) and Deepak Pathak (advisor, Skild AI co-founder), with Ananye Agarwal.
- **Design:** v1 drives each joint directly with a servo and uses a "universal" knuckle that keeps abduction at any flexion angle; it is ~30% larger than a human hand and assembles in under 4 h. v2 (RSS 2025) is a fully printed hybrid rigid-soft hand; v2 Advanced (Humanoids 2025) adds powered palm joints.

- **Evidence:** Blind in-hand cube rotation transferred from Isaac Gym. In the v1 paper's cycling test, Allegro "begins to fail after 15 minutes" while LEAP ran the full hour.
- **Adoption:** The comparison baseline in the ORCA, RUKA and RAPID papers; models in MuJoCo Menagerie, MuJoCo Playground and dex-urdf. No sales or lab counts are published.
- **Trade-offs:** The easiest hand to model and source. Four fingers, oversized, no touch, a non-standard API license, and no new hardware in 2026 (API last pushed Oct 2025).

ORCA Hand

ETH Zurich's tendon-driven, human-sized hand, now sold by the spin-off ORCA Dexterity.

[Site](#) · [v1 paper](#) · [platform paper](#)

- **Who:** Soft Robotics Lab under Robert Katzschmann; Clemens Christoph and Maximilian Eberlein lead the hardware. ORCA Dexterity, Inc. sells kits and assembled hands; orca_core v0.5.2 shipped Oct 1, 2026.
- **Design:** One motor per joint with antagonistic nylon tendons, "poppable" joints that dislocate instead of breaking, and automatic tendon calibration. Variants add joint encoders and Hall-effect fingertip force sensing; motors can be Dynamixel or Feetech. LeRobot-native, with MuJoCo models and teleop via Quest 3, MediaPipe or Manus.
- **Evidence:** Zero-shot sim-to-real ball reorientation after 1 h of Isaac Gym training; learned in-hand reorientation succeeded 9/10 on v2. The v1 tactile skin wore out after 2,000–4,000 cycles.
- **Trade-offs:** The best open five-finger hand with a living company behind it, MIT-licensed software and CC BY 4.0 hardware files. Tendons need periodic tensioning, and durability is proven in thousands of cycles, not millions.

RUKA and RUKA-v2

NYU's human-sized tendon hand that learns its own controller. [Site](#) · [v2 paper](#)

- **Who:** Lerrel Pinto's lab. v1 was led by Anya Zorin and Irmak Guzey; v2 (Mar 2026) adds Raunaq Bhirangi and others.
- **Design:** Forearm motors pull braided line through PTFE tubes. There are no joint encoders by default; per-finger LSTM controllers are learned from MANUS-glove motion capture. v2 adds a wrist, per-finger abduction, optional magnetic joint encoders and eFlesh fingertips.

- **Evidence:** v1 completed 29 of 33 GRASP-taxonomy grasps and scored 10/10 on the Kapandji test. v2 cut teleop completion time by 51% and raised success by 21% over v1 across 13 tasks; learned-controller error averages 8.26°.
- **Trade-offs:** The cheapest human-sized hand with a wrist, and the strongest payload here. Its controllers are trained on MANUS data, which ties good teleop to a \$5k+ glove, and tendon tension varies from build to build.

Aero Hand Open (Chestnut Robotics, formerly TetherIA)

The cheapest credible open hand, with a validated tendon simulation model. [Paper](#) · [docs](#)

- **Who:** Chestnut Robotics, Inc. (formerly TetherIA); Nan Wang and co-authors (Aug 2026 paper).
- **Design:** Seven coreless Feetech servos drive Kevlar/Vectran cables, with coupled fingers and a three-way-coupled thumb; an ESP32-S3 controller; about 13 h of printing. Its MuJoCo model, with 20 spatial tendons, was merged into MuJoCo Playground and Menagerie in Nov 2025. Teleop works with Manus, a webcam or Apple Vision Pro.
- **Evidence:** All 33 GRASP-taxonomy grasps and zero-shot sim-to-real (self-reported).
- **Trade-offs:** The best price-to-capability ratio and sim fidelity of any open hand. Only seven actuators, modest force, and the CAD is non-commercial (CC BY-NC-SA); release notes show recurring overheat and cable-derailment fixes.

AmazingHand (Pollen Robotics / Hugging Face)

The cheapest and easiest open hand: four fingers on hobby micro-servos.

- **Design:** Two parallel servos per finger handle flexion and abduction; printed bones with TPU shells; control from Python or an Arduino. Inspired by the ILDA hand.
- **Trade-offs:** The most-starred open hand repo and permissively licensed (Apache-2.0 code, CC BY 4.0 design). Force, durability and sim models are unpublished, so it suits education and human-robot interaction more than manipulation research.

"DexHand" (three different projects)

- **DexHand V1.0** (Rob Knight of The Robot Studio; ROS 2 work by Trent Shumay) has been dormant since 2023–24; the ORCA authors call it hard to assemble.
- **BiDexHand** (Northwestern, Zhengyang Kris Weng; MIT license) mixes tendon routing and linkages and completes all 33 GRASP grasps; last commit Nov 2025.

- **DexHand021 Pro** (DexRobot) is a commercial 22-DoF hand; no open hardware was found.

ISyHand and RAPID Hand

- [ISyHand](#) (MPI-IS and University of Augsburg, Katherine Kuchenbecker's group; Humanoids 2025) adds an articulated palm, which beat its own fixed-palm version early in RL cube-reorientation training.
- **RAPID Hand** (Sun Yat-sen, UC Merced and CASIA; NeurIPS 2025) syncs dense fingertip touch and a wrist RGB-D camera within 7 ms. It scored 50/50 on rolling and translation and 24/50 on retrieval. The promised hardware release is unverified.

Closed comparators

- **Sharpa Wave** sets the 2026 bar for touch and durability: mass production began Oct 2025 and it won a CES 2026 Innovation Award. Its URDF, USD and MJCF models are open even though the hand is not.
- **Inspire RH56** is the default hand on Unitree builds and in DexUMI — cheap, but only six actuators.
- **Allegro** is the legacy research hand; **Shadow** the legacy high end; **Unitree Dex3-1/Dex5-1**, **Wuji**, **Robotera XHand**, **PSYONIC Ability**, **Tesollo DG-5F** and **AgiBot OmniHand** fill the middle.
- Mid-price closed hands now cost about as much as an assembled open hand, so the case for open hands is modifiability and license, not cost.

Grippers, tactile sensors and hand-data capture

Hand data is the weakest link in the open stack. Gripper capture has scaled to 100,000-trajectory datasets, but open dexterous projects report roughly 40–100 demos per task, Meta's open tactile stack is archived, and most open gloves and exoskeletons are non-commercial or built for a single hand.

Handheld grippers

- [UMI](#) (Universal Manipulation Interface; Shuran Song's lab, Columbia then Stanford, with TRI). A GoPro with a fisheye lens and side mirrors rides on a printed gripper, and ORB-SLAM3 recovers the trajectory, so anyone can record demos without a robot. Parts cost \$73 plus \$298 for the camera. It collected demos 3×+ faster than teleop,

reached 71.7% success in unseen environments and transferred across robots 18/20 times. The core repo is mostly static, but the idea lives on in FastUMI, DexUMI, UMI-on-Legs and Trossen's TRumi, and Tsinghua's RDT2 was trained on 10,000+ hours of UMI-style data.

- [FastUMI-100K](#) (Shanghai AI Lab). A hardware-decoupled UMI that tracks pose with a RealSense T265; its dataset holds 100k+ trajectories (~600 h) across 54 task categories, and $\pi 0$ fine-tunes reach 73–100% on short tasks.
- [PincOpen](#) (Pollen Robotics). A ~€25 printable parallel gripper for the SO-ARM100, derived from Reachy 2's gripper; CC BY-SA 4.0.
- **SO-101 and ALOHA jaws** are the default grippers behind most LeRobot data; ALOHA's original repo is dormant while Trossen sells the continuation.

Tactile sensors

Sensor	Who	Type	Notable evidence	State
Digit 360	Meta FAIR + GelSight	multimodal fingertip	~8.3M taxels, 1 mN sensitivity	free research units; repo quiet since Jul 2025; custom license
DIGIT, TACTO, Sparsh	Meta FAIR	vision tactile sensor, simulator, tactile encoders	Sparsh pretrained on 460k+ tactile images	all archived; Sparsh is non-commercial
AnySkin / ReSkin	NYU, CMU, Meta	swappable magnetic skin	AnySkin: 92% slip detection; policies survive skin swaps	sold by WowRobo; code dormant
eFlesh	NYU	3D-printed magnetic skin	>90% average on 4 visuo-tactile tasks	slowing (Oct 2025)
9DTact	Changyi Lin	vision-based	3D shape plus 6D force; 16 derivative papers	active (Aug 2026); MIT, commercial use welcomed

Sensor	Who	Type	Notable evidence	State
GelSlim 4.0 / Evetac	U. Michigan MMint Lab / TU Darmstadt	vision / event camera	Evetac processes at 1 kHz and senses vibration up to 498 Hz	open designs; activity unverified
GelSight Mini (closed)	GelSight	vision-based	—	quote only

Tactile simulation is early. Isaac Lab's TacSL sensor is marked experimental and modeled on a discontinued GelSight prototype. Taccel (Peking University, BIGAI and UCLA; NeurIPS 2025) runs peg insertion at 915 FPS across 4,096 environments on one H100 (~18× real time), but its code release is unverified. TACTO and DiffTactile are dormant.

Gloves, exoskeletons and retargeting

Device	Who	Captures	Cost	License	State
DexUMI	Stanford, Columbia, NVIDIA et al.	a hand exoskeleton built per target robot hand (Inspire, XHand); video is inpainted to show the robot hand	DIY	MIT	active (Apr 2026)
DOGlove	Tsinghua TEA Lab	21-DoF finger capture with 5-DoF force feedback and haptics	under \$600	MIT	active (Apr 2026)
HOMIE	Shanghai AI Lab + CUHK	arm exoskeleton, 15-DoF Hall gloves and a foot pedal for the G1	~\$500	non-commercial, gated	pushed Sep 2026
Homunculus glove	Hugging Face	Hall sensor on every joint; a LeRobot teleoperator	low	none detected	active
AirExo-2	SJTU	arm exoskeleton for robot-free collection	low	CC BY-NC-SA	light activity
DexCap	Stanford	Rokoko gloves plus SLAM	glove \$1,495	MIT	dormant
Rokoko Smartgloves (closed)	Rokoko	IMU + EMF finger tracking	\$1,495	closed	shipping

Device	Who	Captures	Cost	License	State
Manus Metagloves Pro (closed)	Manus	EMF tracking, 25 DoF	quote (>\$5k)	closed	shipping
SenseGlove Nova 2 (closed)	SenseGlove	force-feedback brakes up to 20 N	\$7,299	closed	shipping

- **Evidence:** DexUMI was 3.2× more efficient than teleop with 86% average task success, but each new hand needs its own exoskeleton (CoRL 2025 best-paper finalist). DOGlove’s force feedback raised in-hand rotation to 10/10, versus 1/10 for vision-only AnyTeleop.
- **Retargeting:** [dex-retargeting](#) (UCSD/NVIDIA, MIT) still sees ~121k PyPI downloads a month but has been idle since Aug 2025; Meta’s GeoRT trains in 1–2 minutes but is non-commercial; dex-urdf lacks ORCA, RUKA, Aero and XHand models.
- **Gap:** no open, commercially licensable glove records both kinematics and force and retargets to many hands — the commercial options cost \$1.5k–\$7.3k per glove, and the open ones are research-grade or license-restricted.

Arms and bimanual rigs

Open arms have split into two tiers. The SO-101 family dominates data volume — 9,400+ Hugging Face datasets carry "so101" in their name — while 2026's research-grade data is moving to \$1.5k–\$7k quasi-direct-drive (QDD) arms such as OpenArm 2.0 and Seeed's reBot, which still have very few public datasets.

Arm	DoF	Reach	Payload	Repeatability	Price	Motors
SO-101	5 + gripper	not published	not published	hand calibration errs ±50–200 ticks per joint	\$122 follower BOM, \$230 leader + follower; kits \$100–\$500	Feetech STS3215 servos
AM-ARM200	6 + gripper	520 mm	1 kg	—	~\$240 follower, ~\$380 pair	STS3215/3095 servos
Koch v1.1	5 + gripper	—	—	—	\$278 follower + \$199 leader	Dynamixel
reBot B601 (DM / RS)	6 + gripper	767 / 754 mm	1.5 / 2.5 kg	<0.2 mm	\$1,436 DM kit + \$240 leader	Damiao / RobStride QDD

Arm	DoF	Reach	Payload	Repeatability	Price	Motors
OpenArm 2.0	7 + gripper per arm	606 mm	4.1 kg nominal, 6 kg peak	—	\$5.6k–\$7.3k bimanual	Damiao QDD
PAROL6	6	400 mm	0.5–1 kg	0.1 mm	—	steppers
AR4 MK3/MK4	6	600 mm	1 kg	0.2 mm	—	steppers
Thor	6	625 mm	0.75 kg	—	under €350 in parts	steppers
Arctos V2	6	—	—	—	\$452 kit without printed parts	steppers
RoArm-M3	5 + gripper	~0.5 m	0.2 kg at 0.5 m	0.088°	—	ST3215 servos
AgileX Piper (closed)	6	626 mm	1.5 kg	0.1 mm	\$1,999	—
Trossen WidowX Core / Pro / Heavy (closed, 2026)	—	700 / 700 / 1,500 mm	2 / 4 / 8 kg	—	\$2,995 / \$3,495 / \$4,995 (proposed)	—
uFactory Lite 6 (closed)	6	440 mm	0.6 kg	±0.5 mm	\$3,349	—

SO-100 / SO-101 (The Robot Studio × Hugging Face)

The default first arm for robot learning, and the center of gravity of the LeRobot community.

- **Who:** The Robot Studio (France) designs the hardware; Hugging Face's LeRobot team maintains the software. HF CEO Clem Delangue called SO-101 "the first robot arms any AI builder should buy". About nine vendors sell kits, including Seeed, WowRobo and PartaBot.
- **Design:** Six bus servos per arm over USB; the leader arm uses mixed gear ratios so it can be back-driven by hand. It has MuJoCo Menagerie models, Isaac Lab support through Lelsaac, and a browser GUI (LeLab).
- **Adoption:** No official sales figure exists. Beyond the name count above, 4,033 datasets mention SO-100, SO-100s make up 31.4% of LeRobot's curated community dataset, and phospho reports 2,000+ robots on its app (self-reported).

- **Evidence:** Community-data pretraining lifted SmolVLA's real SO-100 success from 51.7% to 78.3%. ACT trains on ~50 episodes in 30–60 minutes on an RTX 4090.
- **Trade-offs:** The cheapest way into the biggest ecosystem. Hobby servos mean low payload, backlash and stripped gears (the calibration tool caps torque at 30%), and the sim files ship two calibration conventions.

OpenArm 2.0 (Enactic)

The only fully open, human-scale 7-DoF arm with real payload, now a complete data-collection system.

- **Who:** Enactic, Inc. (Tokyo), led by CEO Hiroto Yamamoto; built by WowRobo, Anvil Robotics, Cereboto and others.
- **Design:** Back-drivable QDD joints over CAN-FD at 1 kHz (Linux only). Version 2.0 (2026) adds a gripper with an in-hand camera. The **KER** leader is motorless and worn like a backpack (1.7 kg, 70%-scale links, 1:1 joint mapping, \$2.4k–\$2.6k). The **OpenArm Cell** is a standardized evaluation enclosure built so that "Model A outperforms Model B" means the same thing across labs. Its own dataset format converts to LeRobot and GROOT.
- **Adoption:** First-class LeRobot support, but only 39 Hugging Face datasets are tagged openarm.
- **Trade-offs:** Bilateral, force-rich teleop that SO-class arms can't do. Linux-only CAN, dependence on Damiao motors, CERN-OHL-S reciprocity and a bespoke data format are the costs.

Seeed reBot Arm B601

Seeed's open "step-up" arm, launched Apr 2026 and already 3.9k stars.

- **Design:** Sheet metal and printed parts with a BOM down to the screw; Damiao (24 V) or RobStride (48 V) variants. Isaac Sim USD files with an NVIDIA sim-to-real course, a browser MuJoCo twin, a Menagerie model and LeRobot core support.
- **License:** OSHWA-certified; moved from a non-commercial license to CERN-OHL-W in May 2026 — a sign vendors are moving toward commercial-friendly terms.
- **Trade-offs:** Fills the gap between SO-101 and OpenArm. Six joints, not seven, and its servo leader cannot do bilateral teleop.

Other open arms

- **Koch v1.1 and Moss** (Jess Moss, after Alexander Koch's original): Dynamixel and Feetech predecessors of SO-100. Koch is still supported in LeRobot but costs about twice as much; Moss is deprecated.
- **PAROL6** (Petar Crnjak / Source Robotics; GPL-3.0): an industrial-style printed stepper arm with a GUI. It is open-loop and has no brakes, so it "falls on power loss", and its docs warn long sessions can overheat the PETG structure — a poor fit for imitation-learning data.
- **AR4** (Annin Robotics; custom license): machined-aluminium stepper arm sold as kits; an MK4 manual appeared Feb 2026.
- **Arctos and Thor**: low-cost printed stepper arms for makers; Arctos's ROS stack targets ROS Melodic, and Thor looks dormant.
- **ROBOTIS OMX and OMY**: Dynamixel arms that ship factory-calibrated (no calibration step) and are in LeRobot core; OMY adds cobot-style gravity compensation.
- **Waveshare RoArm-M3**: an ESP32 Wi-Fi arm with a web UI; very low payload.
- **AM-ARM200 and AlohaMini** (Li Yiteng, 2026): an SO-class upgrade with a 1 kg payload, and a ~\$950 dual-arm mobile robot with a lift (1.1k stars).

Bimanual and mobile rigs

- [ALOHA / ALOHA 2](#) (Tony Zhao and Chelsea Finn; Stanford and Google DeepMind): the recipe that made low-cost bimanual imitation learning work. With 50 demos, ACT scored 84–96% on three of four reported tasks (64% on tape). The original repo is stuck on ROS 1; Trossen's kits and SDKs carry it forward, and 155 Hub datasets are tagged aloha.
- [XLeRobot](#) (Gaotian "Vector" Wang, Rice University): two SO-101 arms on a LeKiwi base and an IKEA cart, ~\$660 in parts or a \$579 kit. Its catalog lists 43 community uses, including papers at ACL, AAAI and HRI 2026.
- [LeKiwi](#) (SIGRobotics UIUC × Hugging Face): the omni-wheel base for SO-101, built into LeRobot.
- **Closed arms that open stacks support**: I2RT YAM (GELLO's recommended arm and the source of AI2's 720-hour MolmoAct2 dataset), AgileX Piper, Trossen WidowX, Franka FR3, Kinova Gen3, UR5e and Unitree Z1 all have LeRobot plugins or Menagerie models.

Teleoperation and data-collection systems

Teleop software is commoditizing quickly, much of it driven by NVIDIA, Hugging Face and robot vendors. What stays hard is throughput, operator fatigue, force feedback and data quality — not the software that streams poses.

System	Type	Robots	Rate or latency	Cost	Latest activity
LeRobot teleop	leader arms, phone, VR, glove, gamepad; DAgger takeover	SO, Koch, OMX, OpenArm, reBot, Reachy 2, Unitree G1	30 fps recording is typical	free	v0.6.1, Aug 3, 2026
GELLO	3D-printed joint-matched leader arm	Franka FR3, UR5, xArm, Lite 6, I2RT YAM, AR4	ROS 2 default was 25 Hz until v2.2	under \$300 per arm (reported)	v2.2.0, Aug 31, 2026
NVIDIA Isaac Teleop	XR, hand and body tracking, Manus gloves, pedals; robot-free egocentric capture	SO-101 example, HOMIE, SONIC	—	free (EULA on first run)	1.4.145, Sep 17, 2026
xr_teleoperate	Vision Pro, PICO 4 Ultra, Quest 3	Unitree G1, H1, H2, R1 plus hands	WebRTC streaming; no latency figure	free	v1.6, Jul 29, 2026
VisionProTeleop	Apple Vision Pro app + Python library	any	<100 ms wireless, ~50 ms wired (self-reported)	free	Dec 2025
OpenArm KER	motorless backpack leader	OpenArm	follower runs 1 kHz	\$2.4k–\$2.6k	Jun 2026
TWIST2	PICO 4U headset, ankle trackers, 2-DoF neck	Unitree G1	—	~\$1,000 + \$250 neck	Dec 2025
SpesRobotics teleop	WebXR from a phone or headset	URDF arms	—	free	Sep 2026
phosphobot	Quest app + web UI	SO arms, Koch, Piper, Go2	—	free; PRO €35/month	Oct 2025
Vuer	WebXR visualization toolkit	—	—	free	Mar 2026

- **GELLO** (Philipp Wu, Pieter Abbeel et al., UC Berkeley) remains the reference for cheap joint-space teleop; its user study found it more reliable than VR controllers or a SpaceMouse. Franka now maintains its FR3 integration, and Wu went on to co-found data company XDof. The CAD is available only by email request.
- **NVIDIA Isaac Teleop** pitches itself as "the unified framework for high-fidelity ego-centric and robotics data collection" and already records human egocentric data without a robot — directly competitive with data-capture startups.
- **TWIST2** (Stanford and Amazon FAR) is the cheapest complete open loop from humanoid teleop to policy: 100 demos in 15 minutes at near-100% success (self-reported), though PICO body pose is weak at elbows and knees.
- **LeRobot v0.6** added DAgger rollouts (take over with the leader arm or a foot pedal; interventions are tagged), phone teleop and an Isaac Teleop bridge.
- **phosphobot** (Paris, YC) also sells custom datasets and models, but releases stopped in Oct 2025 as LeRobot and LeLab absorbed its role.
- **Dormant:** Open-TeleVision (its lineage lives on in Unitree's televuer), Bunny-VisionPro, ACE and AnyTeleop (only dex-retargeting is open).
- **Pain points:** No VR or phone system gives force feedback; Vision Pro streaming adds 50–100 ms; powered leaders tire operators over long sessions (the reason KER exists); and each system writes its own format.

Actuators and motor drivers

Open actuators remain niche. Nearly every open humanoid runs on closed Chinese QDD motors (Damiao, Robstride, Encos) or hobby servos, and the one fully open, high-performance motor controller with momentum is mjbots' moteus.

Component	What it is	Who	State	Used by
moteus	open FOC brushless controller with CAN-FD, Python and C++ APIs (Apache-2.0)	mjbots (Josh Pieper)	v1.0.0 May 28, 2026; v1.1.1 Aug 4, 2026	Upkie and many legged builds

Component	What it is	Who	State	Used by
ODrive	FOC controller	ODrive Robotics	v3 firmware unmaintained; next-gen firmware closed, source "under NDA"	legacy builds
SimpleFOC	Arduino FOC library (MIT)	community	v2.4.0	education, low-power joints
Mini Cheetah actuator + motorcontrol	QDD design and firmware (MIT)	Ben Katz (MIT)	maintenance only	the ancestor of today's Chinese QDD motors
Berkeley Humanoid Lite actuator	3D-printed 15:1 cycloidal gearbox on drone motors (CC BY-SA 4.0)	UC Berkeley	2025	Berkeley Humanoid Lite
OpenQDD	3D-printed QDD actuator	Aaed Musa	unverified	hobby builds
Orbita 2D/3D	parallel wrist and neck actuators	Pollen Robotics	product	Reachy 2

Closed parts the open projects actually buy (prices from project BOMs):

- **Feetech STS3215** — \$13.89 each, 16.5 kg·cm (6 V) or 30 kg·cm (12 V version); inside SO-101, XLeRobot, HopeJR and HumanaOpen.
- **Dynamixel** — ~\$180 per motor in ToddlerBot's 24-motor bundle; precise but expensive.
- **Damiao** — DM-4340P at ¥949 and DM-10010L at ¥1,989 in Roboto Origin's BOM; also OpenArm's and reBot's motors.
- **Robstride** — ~\$157 per motor in LeRobot Humanoid's BOM; RS02 in HopeJR's legs.
- **Encos** — Asimov's leg actuators and joint parts total ~\$8.5k for 12 DoF.
- **Unitree** joint motors are sold only inside Unitree robots.

Why it matters: cheap actuators are where sim-to-real breaks. Every low-cost humanoid project builds its own system-identification rig (ToddlerBot's motor test bed, LeRobot Humanoid's CMA-ES fitting, Microduck's backlash and voltage-sag randomization). No shared, validated actuator-model library exists for the popular motors, even though MuJoCo 3.5 added a system-identification toolbox and actuator delays.

Robot foundation models (open-weight VLAs and world models)

Three hubs dominate open robot models: Physical Intelligence's openpi, NVIDIA's GR00T and Hugging Face's LeRobot, which now wraps most of the others. But the frontier labs stopped opening their best models in 2025–26, most new open releases come from Chinese companies and AI2, and saturated simulation benchmarks hide much weaker real-robot performance.

Model	Org	Params	Open since	Weights license	Action head	LIBERO avg (%)	SimplerEnv WidowX (%)	HF downloads / month
π0.5	Physical Intelligence	~3B	Sep 2025	Gemma terms (commercial with conditions)	flow-matching expert	96.85 (97.5 in LeRobot's re-run)	—	19.4k
π0	Physical Intelligence	~3.3B	Feb 2025	Gemma terms	flow matching	94.2	58.8 (third-party)	12–19k
π0-FAST	Physical Intelligence	~3B	Feb 2025	Gemma terms	autoregressive FAST tokens	85.5	48.3	1.9k
GR00T N1.7	NVIDIA	3B	Apr 2026	NVIDIA Open Model License (commercial)	flow-matching DiT	96.5 (LeRobot run)	—	147k
GR00T N1.6	NVIDIA	3B	~Dec 2025	non-commercial	flow-matching DiT	—	—	29.2k
SmoVLA	Hugging Face	450M	Jun 2025	Apache-2.0	flow matching	~87.3	—	159k
OpenVLA-OFT	Stanford	7.5B	Feb 2025	MIT + Llama 2 terms	parallel decoding, L1	97.1	63.0	13.9k (one checkpoint)
OpenVLA	Stanford et al.	7.5B	Jun 2024	MIT + Llama 2 terms	autoregressive bins	76.5	—	460k
X-VLA	Tsinghua AIR + Shanghai AI Lab	0.9B	Oct 2025	Apache-2.0	flow matching	98.1	95.8	10.5k

Model	Org	Params	Open since	Weights license	Action head	LIBERO avg (%)	SimplerEnv WidowX (%)	HF downloads / month
RDT2	Tsinghua	~8B	Sep 2025	Apache-2.0	RVQ tokens or flow	—	—	0.4k-13.7k
MolmoAct2	AI2	5B	May 2026	Apache-2.0, data included	flow expert + OpenFAST	97.2	—	19.8k
Xiaomi-Robotics-0	Xiaomi	4.7B	Feb 2026	Apache-2.0	flow-matching DiT	98.7	79.2	3.3k
Spirit v1.5	Spirit AI	5B	Jan 2026	MIT / Apache-2.0	DiT	—	—	0.1k
GigaBrain-0.7	GigaAI	~3.5B	Aug 2026	Apache-2.0	"three-system"	—	—	6.0k
DM0.5 / OpenDM	Dexmal	undisclosed	Jul 2026	Apache-2.0	undisclosed	99.0	—	—
LingBot-VLA	Robbyant (Ant Group)	4B	Jan 2026	Apache-2.0	—	—	—	—
WALL-OSS	X Square Robot	4B	Sep 2025	Apache-2.0	flow or FAST	—	—	0.9k
Galaxea G0.5	Galaxea AI	~2B	Jun 2026	non-commercial	autoregressive tokens	98.9	87.3 (Bridge)	—
InternVLA-M1	Shanghai AI Lab	4.1B	Oct 2025	MIT	DiT	95.9	71.7	—
InternVLA-A1	Shanghai AI Lab	3B	Jan 2026	CC BY-NC-SA	mixture of transformers	—	—	0.1k
GO-1	AgiBot	3B	Sep 2025	CC BY-NC-SA	latent planner + diffusion	—	—	0.1k
EO-1	Shanghai AI Lab	3B	Aug 2025	MIT	autoregressive + flow	98.2	72.7	0.1k
VLA-Adapter-Pro	OpenHelix	~0.5B	Sep 2025	MIT	adapter policy	98.5	—	—
Octo-Base	UC Berkeley et al.	93M	2024	MIT	diffusion	75.1	16.8	0.1k

Almost all benchmark numbers are self-reported. Hub download counts are rolling file requests and differ between model cards and listings by up to 30×, so treat them as order-of-magnitude.

Physical Intelligence openpi (π 0, π 0-FAST, π 0.5)

The reference open generalist VLA family, with the most real-world evidence. [GitHub](#) · [\$\pi\$ 0.5 paper](#)

- **Who:** Physical Intelligence (San Francisco), founded by Karol Hausman, Sergey Levine, Chelsea Finn, Brian Ichter, Lachy Groom, Adnan Esmail and Quan Vuong. It raised \$400M in 2024 (\$2.4B valuation), \$600M in 2025 (\$5.6B), and reportedly ~\$1B in 2026 at ~\$11B.
- **Design:** A PaliGemma vision-language model plus a flow-matching "action expert" running up to 50 Hz. π 0.5 co-trains on web data, subtask commands, cross-embodiment data and ~400 h of mobile manipulation to generalize to new homes.
- **Adoption:** 633 Hub fine-tunes of π 0.5; it is the baseline in BEHAVIOR and RoboChallenge, and the BEHAVIOR 2025 winner was built on it.
- **Robustness:** On the independent LIBERO-Plus benchmark, π 0 falls to 15.8% under camera changes and 6.6% under new robot start poses. LIBERO-PRO found π 0 and π 0.5 near 0% when objects move.
- **Trade-offs:** The strongest open generalist and largest community. It is JAX-first (users report PyTorch/JAX accuracy gaps), fine-tuning wants an 80 GB GPU, and no new open checkpoints have appeared since Sep 2025: π^* 0.6 (Nov 2025) and PI's memory work are closed, and users are asking whether more will be opened (issue #980).

NVIDIA Isaac GR00T (N1.5 $\rightarrow$ N1.7, N2 preview)

The open VLA line built around humanoids and hands, now commercially licensed. [GitHub](#) · [model card](#)

- **Who:** NVIDIA's GEAR lab (Jim Fan, Yuke Zhu) and the Isaac team.
- **Design:** N1.7 pairs Cosmos-Reason2-2B (Qwen3-VL architecture) with a flow-matching DiT. Pretraining used 20,000 h of "EgoScale" human video plus robot data, in a relative end-effector action space shared by humans and robots. It reaches finger-level control and drives humanoids (Unitree G1, AgiBot G1) through the SONIC whole-body controller.
- **License shift:** N1.5 and N1.6 weights were non-commercial; NVIDIA staff called it "a data issue, not a license choice". N1.7 fixed that in Apr 2026.
- **Compute:** 27.9 ms per inference on an H100 with TensorRT (~36 Hz) but 216.5 ms on Jetson Orin (~4.6 Hz); fine-tuning wants 40 GB+ GPUs.

- **Adoption:** NVIDIA names AGIBOT, LG Electronics and NEURA Robotics among N1.7 users (self-reported). GR00T N2, a world-action model, was previewed Mar 16, 2026 for release by end of 2026.
- **Trade-offs:** The best open choice for humanoids, hands and commercial terms, with NVIDIA's toolchain around it. Three versions in a year, config confusion in the issue tracker, and slow inference on Orin.

SmolVLA (Hugging Face)

The cheapest open VLA to run and adapt, with by far the most fine-tunes (7,808). [Model](#) · [paper](#)

- **Design:** A SmolVLM2 backbone with a ~100M flow-matching expert, pretrained on 481 community datasets (22.9k episodes, mostly SO-100 arms). Asynchronous inference cuts response time ~30%.
- **Practicalities:** 20k training steps take ~4 h on one A100. The docs say to collect at least 50 episodes: "25 episodes... was not enough".
- **Trade-offs:** Runs on consumer GPUs and lives inside LeRobot. Lower accuracy ceiling, and its pretraining is skewed toward cheap arms, not humanoids or hands.

OpenVLA and OpenVLA-OFT (Stanford)

- **OpenVLA** (Jun 2024): DINOv2 and SigLIP vision encoders with Llama 2, trained on 970k Open X-Embodiment episodes. Still the most-downloaded robotics model on the Hub, but superseded.
- **OpenVLA-OFT** (Moo Jin Kim, Chelsea Finn, Percy Liang; Feb 2025): a fine-tuning recipe — parallel decoding, action chunks, continuous actions with L1 loss — giving 26× throughput. It is the most robust model on LIBERO-Plus (59.7% under camera shifts).
- **Trade-offs:** The standard single-arm baseline, but 7B, trained on 2024-era data and bound by Llama 2 terms.

X-VLA (Tsinghua AIR + Shanghai AI Lab)

A 0.9B Florence-2-based model with per-embodiment "soft prompts", pretrained on 290k episodes across 7 platforms. It won the IROS 2025 AgiBot World Challenge and posts the best simulation scores per parameter (CALVIN 4.43), but its real-robot results are weak (chart below).

RDT2 (Tsinghua)

A Qwen2.5-VL-7B model trained on 10,000+ hours of human demos captured with an improved handheld UMI gripper across 100+ indoor scenes. It claims zero-shot deployment on unseen robots (bimanual UR5e, Franka FR3) and was accepted at ICML 2026. It is the clearest open evidence that wearable or handheld human data scales into robot policies — though only for grippers.

MolmoAct2 (AI2)

The most fully open 2026 release: weights, training code and all training data under Apache-2.0. [Model](#)

- **Design:** 5B, built on Molmo2-ER (an embodied-reasoning model) with a flow-matching expert and OpenFAST, an open re-implementation of the FAST tokenizer. Its data includes 720 h of bimanual YAM teleop, which AI2 calls the largest open bimanual dataset.
- **Evidence:** AI2 reports beating $\pi 0.5$ on seven benchmarks (self-reported) and a third-party Cortex AI evaluation placing it first on 7 of 8 tasks.
- **Trade-offs:** The best base when provenance matters (US nonprofit, data included). Independent replications are still scarce.

The 2026 Chinese wave

Most 2026 open VLAs share one recipe: a 3–6B model with a Qwen-VL backbone and a flow-matching DiT action expert.

- **Xiaomi-Robotics-0** (Feb 2026): top self-reported sim scores (CALVIN 4.75–4.80) and 80 ms inference on an RTX 4090.
- **Spirit v1.5** (Spirit AI, Jan 2026): ranked #1 on RoboChallenge at release; trained "largely on open-ended, goal-driven diverse data" instead of scripted demos — evidence that unscripted collection pays.
- **GigaBrain-0.7** (GigaAI, Aug 2026): a "three-system" model trained on 37,000+ hours of mixed embodied data.
- **DM0 / DM0.5** (Dexmal, Jul 2026): parameters undisclosed; 93.6 on RoboTwin 2.0 (self-reported). Dexmal co-runs RoboChallenge with Hugging Face, a conflict of interest for its leading scores there.

- **LingBot-VLA** (Robbyant, Ant Group, Jan 2026): trained on 20,000 h of real data from 9 dual-arm setups, yet scores only ~16–17% on its own GM-100 benchmark (which it says beats $\pi 0.5$ and GR00T N1.6).
- **WALL-OSS** (X Square Robot): version 0.5 shipped May 2026; the company reportedly raised a \$140M Series A++.
- **Galaxea G0.5** (Jun 2026): built for wheeled mobile manipulators; Galaxea switched to a non-commercial license from G0.5 on.

Shanghai AI Lab and AgiBot

- **InternVLA-M1** (MIT) adds spatial grounding before action training. **InternVLA-A1** (non-commercial) mixes understanding, future-frame generation and action experts, trained on 692M+ frames of real, synthetic and human-video data — a strong signal for synthetic-data vendors.
- **EO-1** (MIT) interleaves reasoning and action in one decoder; its repo moved in Nov 2025.
- **AgiBot GO-1** (Sep 2025) is trained on AgiBot World's 1M trajectories but is non-commercial; **GO-2** (Apr 2026) is closed.

Models aimed at humanoids and hands

- **Unitree UnifoLM-VLA-0** (Jan 2026): a G1-focused VLA trained on 12 open datasets plus G1 data.
- **Being-H0** (BeingBeyond; ICML 2026): pretrained on human hand-motion video with MANO hand models, one of the few open models built for dexterous hands.
- **GR00T N1.7** (above) is the only major open model with finger-level humanoid control.

World models and world-action models

The 2026 trend is video-generation backbones that predict future frames and actions together. They need large action-labelled video corpora and are heavy to run.

- **NVIDIA Cosmos 3** (May 2026): a reasoner-plus-generator "omni-model" in Edge, Nano and Super sizes, commercially usable. Its 16B Nano-Policy-DROID variant claims #1 on RoboArena (self-reported).
- **DreamZero** (NVIDIA GEAR, Feb 2026): 14B on the Wan2.1 video model, ~7 Hz closed loop, non-commercial; the precursor of GR00T N2.

- **Genie Envisioner** (AgiBot): a video world model, action decoder and neural simulator; GE-Act v2.0 shipped Sep 10, 2026 (non-commercial).
- **UnifoLM-WMA-0** (Unitree, Sep 2025): doubles as a synthetic-data engine and a policy enhancer.
- **V-JEPA 2 / 2.1** (Meta): self-supervised video encoders; the action-conditioned variant plans zero-shot on a Franka (100% reaching, 50–80% pick-and-place) but takes ~16 s per action.
- **OpenWAM-Alpha** (Sep 2026): publishes its pretraining mix — 70% robot data (40% real, 30% simulated) and 30% egocentric human video.

Classic single-task policies

Diffusion Policy (Cheng Chi, Shuran Song), ACT (Tony Zhao), DP3 (Yanjie Ze, point clouds) and HPT (Lirui Wang, Kaiming He) have dormant reference repos, but Diffusion Policy and ACT live on in LeRobot, which calls ACT the "recommended first policy".

Closed comparators

- **Gemini Robotics 2** (Google DeepMind, Jul 30, 2026): whole-body control and dexterity for partners only. Five-finger tasks succeed 32–92% of the time; On-Device 2 went from 6.7% to 53.3% on an unseen SO-101 arm, and DeepMind says it typically adapts to new bi-arm robots with under 200 examples.
- **Generalist AI** (GEN-0 to GEN-1.5): trained on 270,000+ hours of real manipulation data growing by 10,000 h a week — two to three orders of magnitude beyond any open dataset.
- **Also closed:** PI's $\pi^*0.6$, Figure Helix, 1X Redwood, Skild Brain and Tesla's Optimus models.

Reading the benchmarks

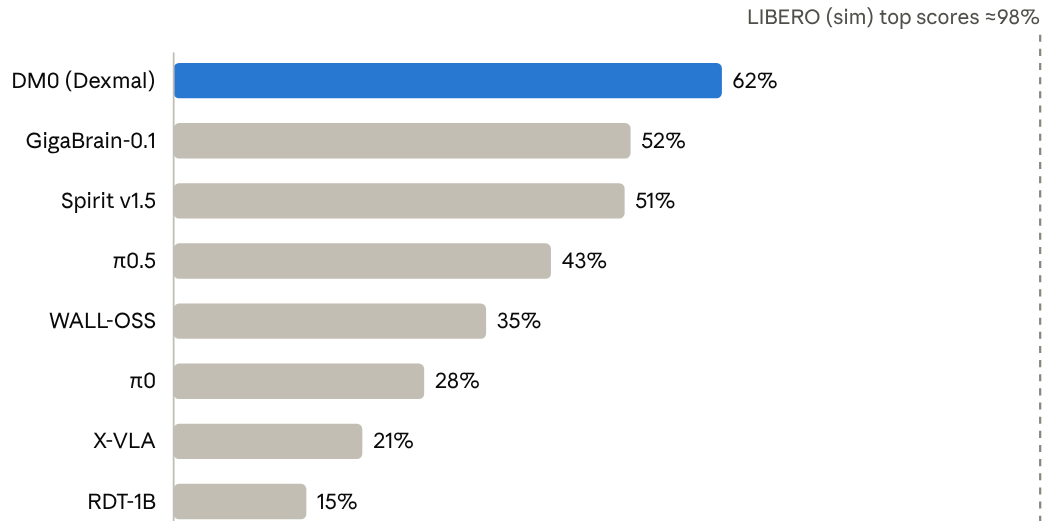
- **LIBERO is saturated:** at least seven models self-report $\geq 98\%$, and LeRobot's $\pi 0.5$ re-run moved 0.65 points with only 10 trials per task.
- **Robustness suites expose memorization:** LIBERO-Plus (CVPR 2026) finds models "tend to ignore language instructions completely" and collapse when the camera moves.
- **Real-robot evaluation is where models separate:** RoboArena (double-blind pairwise trials on DROID setups; $\pi 0$ -FAST-DROID led the paper's seven policies, and GR00T N2 and Cosmos 3 have since both claimed #1) and RoboChallenge (charted below).

- **No standard open benchmark exists for humanoid or five-finger manipulation.**

Real-robot success tops out at 62%, far below ~98% sim scores

RoboChallenge Table30 task success, %, on real robots · leaderboard snapshot ~Apr 2026

DM0 comes from Dexmal, which co-runs the benchmark with Hugging Face



RoboChallenge Table30 leaderboard snapshot via sota2 (~Apr 2026) · 8 open models, fine-tuned per task

These are per-task fine-tunes on a 10-robot fleet. Multi-step tasks such as sandwich-making score near 0%, and generalist versions do far worse: the official Oct 2025 report found $\pi 0.5$ falls from 43.7% task-specific to 17.7% as a single multi-task policy.

Whole-body control, locomotion and motion imitation

Open humanoid control has converged on one pipeline, and its binding constraint is now commercially usable motion data, not algorithms. Nearly every 2025–26 tracker targets the Unitree G1 first, and the strongest one, NVIDIA's SONIC, was trained on 700 hours of private motion capture.

The standard pipeline:

1. **Human motion** from mocap (AMASS, LAFAN1, BONES-SEED), monocular video (GVHMR, VideoMimic) or live VR and egocentric capture (PICO, TWIST2).
2. **Retargeting** to the robot's body: GMR (kinematic, fast) or OmniRetarget (keeps contact with objects and terrain).
3. **RL motion tracking** in GPU simulation — one policy per motion (BeyondMimic) or one generalist (SONIC, TWIST, Humanoid-GPT) — trained in Isaac Lab, mjlab or ProtoMotions.

4. Sim2sim check in MuJoCo.

5. Deployment through ONNX or C++ (often a ROS 2 controller), usually on a G1.

Data quality decides the outcome. In GMR's study, dance clips retargeted by the older PHC method reached 0% tracking success versus 100% with GMR; KAIST's physics-filtered PHUMA data raised G1 tracking success to 92.7% from 76.2% on raw AMASS.

Project	Who	Type	Robots	Simulators	Real robot shown
GR00T-WBC / SONIC	NVIDIA GEAR	generalist tracker + teleop + C++ deploy	G1	Isaac Lab; MuJoCo sim2sim	yes
BeyondMimic	UC Berkeley + Stanford	per-motion tracker + ROS 2 controller	G1 (K1 via Booster)	Isaac Lab, mjlab	yes
holosoma + OmniRetarget	Amazon FAR	full stack + contact-preserving retargeting	G1, Booster T1	Isaac Gym/Sim, MuJoCo Warp	yes
GMR	Stanford (Yanjie Ze)	kinematic retargeting	17 humanoids	CPU only	via TWIST
TWIST / TWIST2	Stanford + Amazon FAR	teleop → tracker → policy	G1	Isaac Gym	yes
ProtoMotions3	NVIDIA Research	simulation and learning framework	SMPL, G1, H1-2	Isaac Gym, Isaac Lab 3, Newton, MuJoCo	yes (G1)
MimicKit	Xue Bin Peng (SFU/NVIDIA)	algorithm suite (DeepMimic, AMP, ASE, ADD)	characters, G1, Go2	Isaac Gym/Lab, Newton	not shown
mjlab	UC Berkeley	Isaac Lab-style API on MuJoCo Warp	G1 and others	MuJoCo Warp	via users
WBC-AGILE	NVIDIA Isaac	Isaac Lab 3 loco-manipulation workflow	G1, T1	Isaac Lab 3	yes
Humanoid-GPT	Galbot	GPT-style zero-shot tracker (inference only)	G1	MuJoCo/MJX	yes
BFM-Zero	CMU LeCAR + Meta	promptable behavior foundation model	G1	Isaac Sim, MuJoCo, mjlab	yes

Project	Who	Type	Robots	Simulators	Real robot shown
unitree_rl_lab / rl_gym	Unitree	vendor locomotion	Go2, G1, H1	Isaac Lab / Isaac Gym	yes
FALCON	CMU LeCAR	force-adaptive loco-manipulation	G1, T1	Isaac Gym	yes
PBHC (KungfuBot)	China Telecom TeleAI	video → highly dynamic skills	G1	Isaac Gym	yes
VideoMimic	UC Berkeley	video → scene-aware policy	G1	—	yes
robot_lab	Ziqi Fan	Isaac Lab extension for ~10 humanoids	many	Isaac Lab	not shown
LocoMuJoCo	TU Darmstadt	imitation-learning benchmark	12 humanoids	MuJoCo, MJX, MuJoCo Warp	no

NVIDIA GR00T Whole-Body Control and SONIC

The biggest open release in humanoid control: one universal tracking policy shipped with weights, a planner, teleop and a production C++ stack. [Paper](#)

- **Who:** NVIDIA GEAR; co-first authors Zhengyi Luo (author of PHC), Ye Yuan, Tingwu Wang and Chenran Li; led by Jim Fan and Yuke Zhu.
- **Design:** A PPO-trained tracker on 700 h of in-house mocap (100M+ frames, 170 subjects), scaled to 42M parameters over ~9k GPU-hours. A motion-token interface accepts PICO VR, three-point VR, video, text, music or VLA outputs; a kinematic planner replans in under 5 ms on a laptop. Training code came out Apr 10, 2026 and a v1.1 checkpoint Jul 23, 2026; code is Apache-2.0 and the weights are commercially usable. The open training recipe uses the public BONES-SEED set (~288 h), not the private corpus.
- **Evidence (self-reported):** 100% success on 50 varied real-world trajectories; three-point VR teleop with 121.9 ms mean latency and 6 cm mean wrist error; a fine-tuned VLA solved an apple-to-plate task 19 of 20 times.
- **Trade-offs:** The only open generalist with a deploy stack. It is G1-centric, its training corpus is private, a full retrain costs ~9k GPU-hours, and users report sim2sim falls and G1 over-temperature warnings.

BeyondMimic (UC Berkeley + Stanford)

High-fidelity per-motion tracking that made aerial cartwheels and spin-kicks transfer zero-shot to a real G1. [Site](#) · [paper](#)

- **Who:** Qiayuan Liao (lead), Takara Truong, Xiaoyu Huang and Guy Tevet, with Koushil Sreenath and C. Karen Liu.
- **Design:** An anchor-body tracking reward and joint impedance tuned to 10 Hz, trained in Isaac Lab on LAFAN1 clips and deployed through a ROS 2 Jazzy C++/ONNX controller. The paper's guided-diffusion planning layer was not open-sourced.
- **Adoption:** Booster adapted it for the K1, HighTorque ported it to the Mini Pi, robot_lab and mjlal reproduce it, and SONIC uses it as a baseline.
- **Trade-offs:** The best fidelity per clip, but one policy per motion. Issues show Isaac Lab version breakage and painful ports to other robots.

mjlal (UC Berkeley)

Isaac Lab's manager-based API running on MuJoCo Warp, and the fastest-rising lightweight alternative. [Paper](#)

- **Who:** Kevin Zakka, Qiayuan Liao, Brent Yi, Louis Le Lay, Koushil Sreenath and Pieter Abbeel.
- **Adoption:** 54k PyPI downloads a month. Microduck, Asimov, BFM-Zero (~6 h of training) and Inria's YAHMP study all build on it.
- **Trade-offs:** One-command install, MuJoCo's contact model, and the same engine for training and sim2sim. It lacks RTX sensors and USD asset tooling, and its FAQ ties some NaN crashes to MuJoCo Warp's beta status.

holosoma and OmniRetarget (Amazon FAR)

The most complete open alternative to NVIDIA's stack across robots and simulators.

- **Who:** Amazon FAR (Frontier AI & Robotics), including Pieter Abbeel, Rocky Duan, Guanya Shi and Carmelo Sferrazza; OmniRetarget is led by Lujie Yang, Xiaoyu Huang and Zhen Wu.
- **Design:** Training with PPO or FastSAC, one inference pipeline for sim2sim and sim2real, and contact-preserving retargeting, for the G1 and Booster T1.
- **Evidence (self-reported):** Sim-to-real locomotion trained in 15 minutes on one RTX 4090; a dance of over two minutes on a real G1; OmniRetarget eliminated foot skating and reached 82% downstream RL success on robot-object interaction.

- **Trade-offs:** No released generalist checkpoint. Only ~4 h of its ~9 h of retargeted data is public, because retargeted LAFAN1 was withheld "due to licensing restrictions".

GMR (General Motion Retargeting)

The default kinematic retargeter, real-time on CPU. [Paper](#)

- **Who:** Yanjie Ze (now at Amazon FAR), with C. Karen Liu and Jiajun Wu at Stanford.
- **Inputs:** SMPL-X (AMASS, OMOMO), BVH (LAFAN1), FBX, Xsens, monocular video via GVHMR, and live PICO streaming for TWIST2.
- **Trade-offs:** Fast and broad, but kinematic only — no dynamics, objects or terrain (use OmniRetarget for those). Users report arm offsets and T-pose calibration issues, and maintainer news stops in Jan 2026.

TWIST and TWIST2 (Stanford + Amazon FAR)

A cheap, fully open loop from humanoid teleop to learned policy. TWIST2's tracker trains on ~20k clips (7k retargeted with GMR); a Diffusion Policy on 224×224 RGB with 2-second action chunks then drives a G1 with Dex3 hands. Code is MIT and the datasets CC BY 4.0. See the teleop section for its capture rig.

ProtoMotions3 and MimicKit

- **ProtoMotions3** (NVIDIA Research: Chen Tessler, Xue Bin Peng, Erwin Coumans and others) supports the most backends (Isaac Gym, Isaac Lab 3, Newton 1.0, MuJoCo). It trains on all of AMASS in 12 h on four A100s, and a general tracker trained on BONES-SEED transfers zero-shot to a real G1.
- **MimicKit** (Xue Bin Peng) offers clean reference implementations of DeepMimic, AMP, ASE, ADD and more, for research and teaching rather than deployment.

Vendor and community stacks

- **Unitree** unitree_rl_gym (Isaac Gym) and unitree_rl_lab (Isaac Lab 2.3) are the standard start for G1 locomotion; neither covers general motion tracking.
- **Booster** moved from booster_gym to booster_train, which adapts BeyondMimic for the K1.
- **NVIDIA WBC-AGILE** is an engineering-grade Isaac Lab 3 workflow for the G1 and T1 with a built-in evaluation framework.

- **robot_lab** brings ~10 humanoids into Isaac Lab, including OpenLoong and Roboto's ATOM01.
- [rsl_rl](#) (ETH RSL) is the PPO library underneath most of these, with 13 PyPI releases in 2026.

Newer generalists and foundation controllers

- **Humanoid-GPT** (Galbot, CVPR 2026): a GPT-style tracker trained on 2 billion motion frames; only inference code and checkpoints are released.
- **BFM-Zero** (CMU LeCAR + Meta, ICLR 2026): one policy that can be prompted for tracking, goal-reaching or reward optimization; non-commercial license.
- **EgoHumanoid** (OpenDriveLab, RSS 2026): loco-manipulation learned from egocentric human demos, reporting +51% over robot-only data (self-reported), with GR00T WBC as its low-level controller.

The 2024–25 generation, now mostly dormant

ASAP (CMU's learned "delta action" sim-to-real correction), HOVER (NVIDIA + CMU), H2O/OmniH2O (non-commercial), PHC (the AMASS-scale baseline), GMT (checkpoint only), HumanPlus, Humanoid-Gym and legged_gym. Many flagship repos, including TWIST2, HOMIE, FALCON and PBHC, still require Isaac Gym on Python 3.8.

Model-based libraries

These are healthy but now serve mostly as IK, retargeting and hybrid-control components rather than complete humanoid stacks.

- [Pinocchio](#) (Inria and LAAS-CNRS) is the rigid-body dynamics base layer; Crocoddyl and Aligator add trajectory optimization; TSID, [Pink](#) and PlaCo add task-space IK and inverse dynamics; [mink](#) does differential IK on MuJoCo.
- [Drake](#) (TRI), MuJoCo MPC (Google DeepMind), OCS2 (ETH) and IHMC Open Robotics Software (Java whole-body control from the Valkyrie and Nadia lineage) cover MPC and verification.
- Integrated open MPC+WBC humanoid stacks (legged_control, OpenLoong-Dyn-Control) are discontinued or dormant. Hybrids are returning: HybridMimic (Booster T1, 2026) lets an RL policy modulate a centroidal controller and reports 13% lower tracking error than pure RL.

Simulators, physics engines and training frameworks

Rigid-body simulation consolidated in 2025–26. Newton (a Linux Foundation project started by NVIDIA, Google DeepMind and Disney) and MuJoCo Warp became the shared GPU core, Isaac Lab 3.0 can run without Isaac Sim, and Meta and NVIDIA retired Habitat and Isaac Gym. The defensible value has moved up the stack: assets, scenes, calibration and evaluation.

Simulator	Maintainer	GPU-parallel	Physics	Rendering	Formats	Humanoids / hands
MuJoCo (+MJX)	Google DeepMind	via MJX (JAX)	convex soft-contact solver	OpenGL	MJCF, URDF (partial)	yes / yes
MuJoCo Warp	Google DeepMind + NVIDIA	yes (CUDA)	MuJoCo	ray-traced batch renderer, Gaussian splats	MJCF	yes / yes, slow beyond ~60 DoF per tree
Newton	Linux Foundation	yes (CUDA; macOS CPU only)	MuJoCo Warp, Featherstone, XPBD, VBD, MPM and more	Warp ray tracing, splats	USD, MJCF, URDF	yes / yes
Isaac Sim	NVIDIA	yes	PhysX 5 (+Newton)	RTX, NuRec splats	USD, URDF, MJCF, CAD	yes / yes
Isaac Lab	NVIDIA + community	yes	PhysX, Newton, OVPhysX	Isaac RTX, OVRTX, Newton Warp	USD + importers	yes / yes
Genesis World	Genesis AI	yes (CUDA, ROCm, Metal, Vulkan)	rigid, FEM, MPM, SPH, PBD, IPC	Nyx (splats), ray tracing	URDF, MJCF, USD, GLB	yes / yes, plus tactile
ManiSkill3 / SAPIEN	UCSD + Hillbot	yes (Linux)	PhysX 5	Vulkan	URDF, MJCF (partial)	a few humanoid tasks / yes
Drake	Toyota Research Institute	no	hydroelastic contact, SAP	Meshcat, VTK	URDF, SDF format	limited
Gazebo	Open Robotics / Intrinsic	no	DART, Bullet	OGRE 2	SDF, URDF	limited

Simulator	Maintainer	GPU-parallel	Physics	Rendering	Formats	Humanoids / hands
Webots	Cyberbotics	no	ODE	OpenGL PBR	PROTO, URDF	some
Project Chrono	UW-Madison	partial	multiphysics, FEA, granular	Irrlicht, VSG	URDF	niche

NVIDIA's own Isaac Lab benchmark (Sep 2026; 8,192 environments on an RTX PRO 6000 Blackwell; end-to-end training FPS) shows the Newton backend roughly 1.5–2× faster than PhysX:

Task	PhysX	Newton / MuJoCo Warp	OVPhysX
Velocity-Flat-G1	136,950 (11.6 GB VRAM)	264,026 (4.3 GB)	176,802 (9.3 GB)
Velocity-Flat-H1	220,167	377,693	295,423
Velocity-Rough-G1	112,096	169,352	152,929
Reorient-Cube-Shadow	112,490	238,886	68,977

NVIDIA ran these itself; the rows are flagged "dirty working tree", Newton runs often vary >25% between runs, and contact parameters differ across backends.

MuJoCo, MuJoCo Warp, Menagerie and Playground (Google DeepMind)

The reference engine for contact-rich robotics, now with a GPU twin.

- **MuJoCo:** 4.0M PyPI downloads a month and monthly releases since 3.5 (Feb 2026), which added a system-identification toolbox and actuator and sensor delays. 3.14 (Sep 22, 2026) added experimental penetration-free contact for deformables.
- **MuJoCo Warp:** "officially released" in Feb 2026 as an NVIDIA-GPU rewrite with a batch renderer that draws Gaussian splats. It is the main solver behind Newton, Isaac Lab 3's Newton mode, mjlab and Playground (383k downloads a month). Its docs warn it scales poorly beyond ~60 DoF in one kinematic tree — a G1 with two dexterous hands exceeds that.
- **[Menagerie](#):** 71 curated robot models, including 11 humanoids and 6 dexterous hands, now pip-installable; licenses vary by model.

- [Playground](#) (RSS 2025): GPU environments that "train policies in minutes on a single GPU", with zero-shot sim-to-real on humanoids, quadrupeds and hands.
- **Trade-offs:** Best accuracy, determinism and fewest dependencies. Basic rendering, and USD only through converters.

Newton (Linux Foundation)

The new shared GPU physics engine, with one API over interchangeable solvers.

- **Who:** Started by NVIDIA, Google DeepMind and Disney Research. Its steering committee includes Yuval Tassa (DeepMind), Miles Macklin (NVIDIA), Disney's Vassilios Tsounis and Moritz Baecher, and TRI's Drake developers.
- **Releases:** 1.0 on Mar 10, 2026, then monthly releases to 1.6 on Sep 10, 2026.
- **Design:** MuJoCo Warp and Featherstone for articulated robots; XPBD, VBD (cloth and soft bodies) and MPM (granular); experimental hydroelastic contact; USD, MJCF and URDF import.
- **Trade-offs:** The broadest open multi-solver engine with neutral governance. APIs change every minor release, several solvers are experimental, and speed requires NVIDIA GPUs.

NVIDIA Isaac Sim, Isaac Lab and Isaac Lab-Arena

The default stack for humanoid sim-to-real, now modular.

- **Isaac Sim:** source code Apache-2.0 on GitHub since 5.0 (Aug 2025), but building it needs NVIDIA's proprietary Omniverse Kit SDK. 6.0 (Jun 2026) added NuRec Gaussian-splat scenes; 6.1 followed in Sep 2026. Minimum GPU: RTX 4080 or A40.
- **Isaac Lab:** BSD-3, 16+ robots and 30+ environments. Version 3.0 (Early Access Sep 16, 2026) splits physics (PhysX, Newton, OVPhysX) and rendering into plug-ins and can run without Isaac Sim. Its Mimic data-generation module requires NVIDIA's proprietary cuRobo.
- **Isaac Lab-Arena** (alpha): builds environments from a scene, an embodiment and a task, with experimental natural-language environment generation and perturbation sweeps — the same space an environments startup would target.
- **Adoption:** Isaac Lab has 3.9k forks; unitree_rl_lab, BeyondMimic, holosoma and RoboTwin build on it.
- **Trade-offs:** The richest sensors and assets. Heavy installs, a high GPU floor, breaking 2.x → 3.0 changes and mixed licensing.

Genesis World (Genesis AI)

The one VC-backed independent simulator, and the only fast option across GPU vendors.

- **Who:** Began as an academic project in Dec 2024; now run by Genesis AI (CEO Zhou Xian), which raised a \$105M seed in Jul 2025 led by Eclipse and Khosla Ventures. Version 1.0 shipped May 27, 2026, with roughly weekly releases since.
- **Design:** Rigid, FEM, MPM, SPH, PBD and IPC solvers in one scene; NVIDIA, AMD, Apple and Vulkan GPUs through its own compiler (Quadrants); tactile sensors.
- **Controversy:** Its Dec 2024 README claimed 43M FPS (430,000× real time) for a Franka arm on one RTX 4090. ManiSkill's Stone Tao argued the number came from a near-trivial setup; the claim was dropped, and CI benchmarks now gate contributions. No independent head-to-head of Genesis 1.x was found.
- **Strategy:** The company has gone "full stack" with its own hand (with Wuji), a data glove and the GENE-26.5 model; its CEO says simulation's main value is evaluation.
- **Trade-offs:** The widest multiphysics and cross-vendor support, but damaged credibility on speed and a smaller ecosystem.

ManiSkill3 / SAPIEN (UCSD + Hillbot)

Hao Su's GPU-parallel manipulation simulator, notable for running a different scene in every parallel environment. It claims 30,000+ FPS with rendering and, in an older self-run comparison, 2.2× Isaac Lab's throughput on visual CartPole at a quarter of the memory. Easiest pip install and efficient visual RL; Linux-only GPU mode and thin humanoid coverage.

Drake, Gazebo, Webots and Chrono

- **Drake** (TRI; monthly releases) is best for verification and model-based manipulation with hydroelastic contact, not massively parallel RL.
- **Gazebo** (Jetty LTS, supported to 2031) is the standard for ROS integration testing, not GPU training.
- **Webots** (Cyberbotics) last tagged a release in early 2025 and suits teaching.
- **Project Chrono** (UW-Madison; 10.0 in Mar 2026) covers deformable terrain, vehicles and granular media.
- **PyBullet** is legacy, and Brax now maintains only its training library.

Benchmark environments and scene suites

- [RoboCasa365](#) (UT Austin, Yuke Zhu; v1.0 Feb 2026): 365 tasks, 2,500+ kitchen scenes, 3,200+ objects, 600+ h of human demos and 1,600+ h of generated robot data; assets CC BY 4.0, CPU MuJoCo.
- [BEHAVIOR-1K / OmniGibson](#) (Stanford; Fei-Fei Li, Jiajun Wu): 1,000 household activities on Isaac Sim with fluids, cloth and object states.
- [RoboTwin 2.0](#) (ICML 2026): a bimanual benchmark and data generator; its paper reports domain-randomized synthetic data plus 10 real demos improved success 367% (relative).
- [RoboVerse](#) puts one API over 8+ simulators; Gymnasium-Robotics, Meta-World, MyoSuite and dm_control remain maintained.

Procedural scenes, real-to-sim twins and world models

- [Infinigen](#) (Princeton; 2.0 alpha Jul 2026) generates procedural scenes and sim-ready articulated assets in Blender — the most credible open generator, though outputs need physics tuning per simulator. The 2023–24 LLM generators (Holodeck, RoboGen, GenSim) are dormant.
- **Gaussian-splat twins:** Isaac Sim's NuRec, MuJoCo Warp, Newton and Genesis all render splats. GaussGym (Berkeley) claims 100,000+ steps/s on consumer GPUs with iPhone-scanned and Veo-generated scenes; DISCOVERSE and GS-Playground pair splats with physics. Splats carry appearance only — not mass, friction or articulation.
- **World models as simulators:** NVIDIA Cosmos 3 is open and commercially usable; 1X's open challenge offers 100+ h of EVE robot video; Google's Veo-based policy evaluator (validated on 1,600+ real trials) and Genie 3 are closed.

What it means: rigid-body physics is becoming a free, well-funded commodity, so building another solver is a poor bet. The gaps are sim-ready assets in both USD and MJCF with tuned physics, procedural scene and task generation, calibrated actuator models, real-to-sim twins that include physics, and evidence that simulated results predict real ones.

Middleware and tooling

LeRobot has become the de facto robot-learning toolchain and dataset format — 77,000+ Hub datasets are tagged LeRobot — while ROS 2 remains the systems backbone. 2026 brought dora-rs 1.0, Copper 1.0, ROS 2 Lyrical with zero-copy GPU buffers, and Qualcomm's deal to buy PickNik, MoveIt's steward.

LeRobot (Hugging Face)

The end-to-end PyTorch library, dataset format and Hub ecosystem that most open robot learning now runs through. [GitHub](#) · [paper](#)

- **Who:** Hugging Face's robotics team in Paris. Original lead Rémi Cadène left to found UMA (Paris), which is building the "Northstar" humanoid with LeRobot co-founder Simon Alibert, SO-100 designer Robert Knight and ex-DeepMind researcher Pierre Sermanet; Thomas Wolf advises it. Releases are now cut by Steven Palma with Caroline Pascal, Pepijn Kooijmans and others.
- **Hardware:** Native support for SO-100/101, LeKiwi, Koch, HopeJR, OMX, Reachy 2, OpenArm, reBot and the Unitree G1 (whole-body control since v0.5). Plugins are auto-discovered for xArm, UR5e, Franka, Piper, WidowX, ARX5, I2RT YAM, GELLO, Quest, ROS 2 bridges and tactile cameras.
- **Policies:** ACT, Diffusion, VQ-BeT and Multitask DiT; HIL-SERL and TD-MPC for RL; $\pi 0$, $\pi 0$ -FAST, $\pi 0.5$, GR00T N1.7, SmolVLA, X-VLA, EO-1, MolmoAct2 and WALL-OSS; world models (VLA-JEPA, LingBot-VA, FastWAM) and reward models (SARM, TOPReward, Robometer).
- **Dataset format v3.0** (Oct 2025): many episodes packed per Parquet/MP4 file, streaming straight from the Hub, and an optional LanceDB backend. v0.6 (Jul 2026) added depth, video trim and re-encode tools, language columns with a VLM subtask-annotation pipeline, recording of evaluation rollouts, DAGger takeovers, cloud training on HF Jobs and Foxglove visualization. Benchmarks plug in through "EnvHub" (LIBERO, MetaWorld, RoboCasa365, RoboTwin 2.0, VLABench and more).
- **Adoption:** 238k PyPI downloads a month; an ICLR 2026 paper; its Jun 2025 worldwide hackathon drew 3,000+ participants in 44 countries (self-reported).
- **Trade-offs:** Learning-centric and Python-first, not a real-time middleware. Every release breaks something (v0.5 requires Python 3.12; v0.6 renamed modules), and v2.1 → v3.0 conversions have corrupted episode boundaries in the wild.

ROS 2 and its ecosystem

- [ROS 2 Lyrical Luth](#) (May 22, 2026; LTS to May 2031) targets Ubuntu 26.04 and adds zero-copy `rosidl::Buffer` publishing with pluggable GPU backends. `rmw_zenoh` has been Tier 1 since Kilted, and MCAP has been the default bag format since Iron.
- [MoveIt 2](#) (BSD-3): Qualcomm agreed on Sep 23, 2026 to acquire PickNik and pledged to keep MoveIt open source; MoveIt Pro stays proprietary.

- [ros2_control](#) is the standard hardware abstraction; BeyondMimic's real-robot controller is built on it.
- [NVIDIA Isaac ROS 5.0](#) (Sep 21, 2026) moved to Lyrical and replaced its NITROS transport with native GPU buffers; 4.6 added cloud-control workflows for the Unitree G1.

Lightweight runtimes

- [dora-rs 1.0](#) (Sep 2, 2026): YAML-defined dataflow graphs of Rust, Python and C++ nodes exchanging Apache Arrow messages, zero-copy over Zenoh shared memory. It claims 10–17× lower latency than ROS 2's rclpy (self-reported) and is used by LeRobot Humanoid and OpenArm's data collection.
- [Copper-rs 1.0](#) (Jul 2, 2026): a deterministic, compile-time-scheduled Rust runtime with structured logging and exact replay.
- [Zenoh](#) (Eclipse Foundation, backed by ZettaScale): pub/sub that survives Wi-Fi and WAN links; it underpins rmw_zenoh and dora.

Visualization and logging

- [Rerun](#) (Stockholm; ~\$17M seed in Mar 2025): multimodal logging and a viewer; LeRobot's dataset visualizer is built on it.
- [MCAP](#) (MIT): the self-describing log container and ROS 2 default. Foxglove's app went proprietary in 2024; BMW-led [Lichtblick](#) (MPL-2.0) continues the open Foxglove Studio code.
- [Viser](#) (Brent Yi and collaborators): browser-based 3D GUIs from Python, with 837k downloads a month.

Assets and data plumbing

- [robot_descriptions.py](#) (Stéphane Caron): one-line imports of 100+ URDF and MJCF models; 3.2.0 shipped Sep 12, 2026.
- [any4lerobot](#): converts Open X-Embodiment, AgiBot World, RoboMIND, LIBERO and RoboCasa to LeRobot and migrates between v2.1 and v3.0.
- **LanceDB and FiftyOne**: general data tools now used for robot datasets (LeRobot's Lance backend; Voxel51 hosts Egocentric-10K subsets).
- **trajlens**: a new LeRobot dataset linter; its author's audit of 100 public LeRobot datasets found 81% had issues or failed to load cleanly.

- **Fading:** phosphobot (no release since Oct 2025), RLDS (the legacy Open X-Embodiment format) and YARP (iCub only).

Datasets and benchmarks

Open robot data is growing fast but remains small, noisy and mostly non-commercial. The largest real-robot and hand datasets forbid commercial use, 2026's big open releases are egocentric human video, and evaluation is shifting from saturated simulation suites to real-robot and long-horizon tests.

Robot datasets

Dataset	Size	Embodiment	Notable modalities	Commercial use
AgiBot World Beta	1.0M trajectories, 2,976 h	100 AgiBot robots, dexterous subset	RGB-D, force/torque, visuo-tactile subset	no (CC BY-NC-SA, gated)
Open X-Embodiment	1M+ trajectories	22 embodiments, 60 pooled datasets	mostly RGB, grippers	yes (CC BY 4.0; check each sub-dataset)
GR00T X-Embodiment-Sim	~325k sim trajectories	GR1 humanoid, Panda and others	simulated	yes (CC BY 4.0)
RH20T	110k+ sequences	7 arm configurations	force/torque, audio, tactile on one configuration	split: part BY-SA, part non-commercial
RoboMIND	107k trajectories	Franka, UR5e, Tien Kung humanoid (19k), AgileX	RGB, state	yes (Apache-2.0, gated)

Dataset	Size	Embodiment	Notable modalities	Commercial use
DROID	76k trajectories, 350 h, 564 scenes	Franka	stereo RGB, language	HF port Apache-2.0
BridgeData V2	60k trajectories	WidowX	RGB-D, language	yes (CC BY 4.0)
Axis Sim V1 (Sep 2026)	50k+ sim trajectories	Franka FR3 in sim, crowdsourced via browser	simulated	"open", terms unclear
Fourier ActionNet	30k+ trajectories, ~140 h	GR1/GR2 with dexterous hands	egocentric RGB, state	no
BEHAVIOR 2026 demos	20k demos, 1,950 h	Galaxea R1 in sim	RGB-D, segmentation, subtasks	not verified
Humanoid Everyday	10.3k trajectories, 260 tasks	humanoid	RGB-D, LiDAR, tactile	not stated
Galaxea Open-World	500+ h, 227 tasks	R1-Lite mobile bimanual	4 RGB views, IMU, language	no
NVIDIA GRAIL (Jun 2026)	22k motions, ~55 h	Unitree G1, physics-validated in sim	human-object interaction	yes (Apache-2.0)
MolmoAct2 data (May 2026)	720+ h	bimanual I2RT YAM	RGB, language	not verified
Unitree G1 datasets	162 datasets of ~40-120 episodes	G1 with Dex1, BrainCo or Inspire hands	head stereo + wrist cameras; whole-body teleop	not shown

Dataset	Size	Embodiment	Notable modalities	Commercial use
TacVerse	~1.3k episodes	bimanual	visuo-tactile	yes (CC BY-SA)
RoboArena data dump	23.6k evaluation sessions	Franka (DROID setup)	rollouts with success and preference labels, failures included	yes (MIT)
LeRobot community	77k+ tagged datasets; median 10 episodes (Sep 2025 crawl)	mostly SO-100/101	varies	varies, often unlicensed

Egocentric human data

Dataset	Size	Capture	Labels	Commercial use
Build AI Egocentric-100K	100,405 h	head-mounted fisheye on factory workers	video only, 456×256	yes (Apache-2.0, gated)
Lightwheel EgoSuite-Open100K (Aug 2026)	10k h live, 100k planned	head and wrist cameras	hand and body pose; LeRobot v3 + MCAP	commercial training allowed (per blog)
Open-AoE (Ant Group, Jul 2026)	~2,000 h	smartphones (400+ models)	MANO hand pose, camera trajectory	yes (CC BY 4.0)
EgoVerse (Apr 2026)	1,362 h, 80k episodes	2,087 demonstrators worldwide	standardized annotations	see egoverse.ai
Ego-Exo4D V2 (Meta and partners)	1,286 h	Aria + GoPro	multi-view, 3D	custom agreement

Dataset	Size	Capture	Labels	Commercial use
OpenEgo	1,107 h	merges 6 sources	MANO-21 hands	mixed, inherited
EgoDex (Apple)	829 h	Apple Vision Pro	3D hand and upper-body pose	no (CC BY-NC-ND)
HA-Ego-500 (Human Archive)	500 h	multi-camera rigs	310k+ labeled steps	not disclosed
HOT3D (Meta)	~14 h	Aria, Quest 3	mocap-grade hands and objects	custom agreement

EgoVerse found human data improves robot policies only when it is aligned with the robot's objective; raw volume alone does not help.

Human motion data for humanoid control

Dataset	Size	Used by	Commercial use
AMASS	40+ h, 300+ subjects	PHC, H2O, HOVER, ASAP, ProtoMotions	no — bans training for commercial use
LAFAN1 (Ubisoft)	~4.6 h	BeyondMimic, holosoma, GMR's evaluation	no (CC BY-NC-ND)
BONES-SEED (Mar 2026)	142k motions, ~288 h, 522 performers	SONIC, ProtoMotions, Kimodo	gated custom license; commercial by inquiry
PHUMA (KAIST)	73 h, physics-filtered	ProtoMotions	Apache-2.0, but LAFAN1-derived clips withheld
OmniRetarget (Amazon FAR)	4 h public	holosoma	yes (MIT)

Dataset	Size	Used by	Commercial use
OMOMO	~10 h of human-object interaction	holosoma, GMR	MIT code; SMPL body models non-commercial
NVIDIA Kimodo (Apr 2026)	synthetic motion generator trained on BONES-SEED	ProtoMotions, GR00T WBC	NVIDIA Open Model License
SONIC training corpus	700 h	SONIC	private

Benchmarks and competitions

Benchmark	Measures	Run by	Latest leader
BEHAVIOR Challenge	long-horizon household tasks in sim (50 in 2025, 100 in 2026), partial-credit q-score	Stanford	2025: Robot Learning Collective (built on $\pi 0.5$), 26% q-score, ~12% binary success; 2026 winners due Nov 4, 2026
RoboChallenge Table30	real-robot fleet, success and progress	Dexmal + Hugging Face	see chart in the models section; the organizer's own model leads
RoboArena	double-blind pairwise real-robot trials on DROID setups	7-institution consortium	live board unreadable; GR00T N2 and Cosmos 3 both claim #1
AgiBot World Challenge (ICRA 2026)	reasoning-to-action and world-model tracks; sim rounds, then real AgiBot G2 finals	AgiBot	526 teams; PrismBot (vivo) and NeoVerse-ABot won

Benchmark	Measures	Run by	Latest leader
RoboTwin 2.0	50 bimanual tasks, clean vs randomized	RoboTwin team	paper baseline $\pi 0$ 46.4% clean / 16.3% randomized; leaders self-report ~93%
ArmnetBench (Jul 2026)	12 tasks on \$359 SO-101 evaluation cells	Armnet	$\pi 0.5$, 47.6% strict success
LIBERO	130 simulated tasks	UT Austin	saturated
HumanoidBench	27 simulated humanoid tasks	UC Berkeley	dormant
World Humanoid Robot Games (Aug 2026)	athletics and skills	Beijing	666 teams from 16 countries; a 9.39 s 100 m heat time (reported)
RoboCup 2026 Humanoid	soccer	RoboCup Federation	B-Human (Middle), Invic (Small), Tsinghua Hephaestus (Large)

The data market

Money is flowing into robot-data suppliers, and prices are already compressing.

- **Suppliers (funding as reported):** XDOF (\$70M; co-founded by GELLO's Philipp Wu and Fred Shentu with Nemo Jin; about 20 customers including frontier labs), Scale AI (Physical Intelligence and Generalist as customers), Lightwheel (SimReady assets plus EgoSuite; customers include Google DeepMind and Figure), Mecka AI (about \$68M; body-worn sensors; 1X as a customer), Config (\$27M seed at a \$200M valuation), Human Archive (\$8.2M; YC W26), Build AI (about \$15M), Encord (\$60M Series C; curation tooling), Bones Studio (studio mocap), Luel (rights-cleared marketplace), Axis Robotics (\$12M; crowdsourced sim teleop), Genesis AI (a closed tactile data glove) and MANUS (gloves).
- **Published prices (vendors, Jul-Sep 2026):** \$15–40 per raw hour of egocentric video; \$28–60 per hour of teleop; \$8–25 per hour extra for annotation; \$80–150 per hour for full humanoid multi-sensor capture. Raw footage resells for \$2–5 per hour, buyers discard ~90% of it, and collectors in India earn \$1–4.20 per hour.

- **Formats:** LeRobotDataset (v3.0) for training and distribution; MCAP for raw logs; legacy RLDS, HDF5, WebDataset and Aria VRS elsewhere.

Trade-offs and recommended stacks

If you are starting today, the safe defaults are a Unitree G1 or SO-101/OpenArm for hardware, Isaac Lab or mjlab on MuJoCo or Newton for simulation, LeRobot v3 for data, and π 0.5, GR00T N1.7 or SmoIVLA as the base model. The real decisions are licensing and how much of the hardware you want to own.

Goal	Recommended open stack	Why	Watch out for
Learn robot learning cheaply	SO-101 (+ LeKiwi or XLeRobot), LeRobot, ACT then SmoIVLA	biggest community, cheapest arms, trains on one GPU	servo backlash, calibration noise, tiny public datasets
Research-grade manipulation data	OpenArm 2.0, reBot or I2RT YAM; GELLO or KER leaders; LeRobot v3; π 0.5 or GR00T N1.7	payload, back-drivability, bilateral teleop	Linux-only CAN, few public datasets, copyleft hardware
Humanoid whole-body control	Unitree G1; mjlab or Isaac Lab; GMR + BeyondMimic or holosoma; SONIC as a ready-made controller	every recent tracker targets the G1	closed actuators; motion-data licenses
Own the humanoid hardware	Berkeley Humanoid Lite (research), ToddlerBot (small, robust), Asimov or Roboto Origin (full size)	open actuators or complete BOMs	gear wear, no released walking policy (Asimov), non-commercial designs (ToddlerBot)
Dexterous hands	ORCA (company; MIT software, CC BY 4.0 hardware), Aero Hand Open (cheapest, best sim model), RUKA-v2 (wrist, payload); LEAP as the baseline	living projects with sim models	tendon maintenance; durability measured in hours

Goal	Recommended open stack	Why	Watch out for
Ship a commercial product	Models: GR00T N1.7, π 0.5 (Gemma terms), SmolVLA, X-VLA, MolmoAct2, RDT2. Control: SONIC, holosoma, GMR, mjlalab	permissive or explicitly commercial terms	avoid non-commercial pieces: GO-1, InternVLA-A1, Galaxea G0.5+, DreamZero, BFM-Zero, H2O, PBHC, HOMIE, and data such as AgiBot World, EgoDex, AMASS and LAFAN1
Simulation	MuJoCo / MuJoCo Warp for accuracy and light installs; Isaac Lab 3 for sensors and USD; Newton as the shared core; Genesis for non-NVIDIA GPUs and multiphysics; ManiSkill3 for visual manipulation	each wins a different axis	API churn everywhere; NVIDIA lock-in for GPU speed

Where the open ecosystem is thin

These are the gaps a data, simulation or environment company could fill, with the evidence behind each.

- 1. Commercially licensed data with provenance.** The largest open robot, hand and motion datasets (AgiBot World, Galaxea, ActionNet, EgoDex, AMASS, LAFAN1) are non-commercial. NVIDIA said GR00T's earlier non-commercial weights were "a data issue, not a license choice".
- 2. Hand data with force and touch.** Open gloves are research-grade or license-restricted; commercial gloves cost \$1.5k–\$7.3k; open dexterous datasets hold ~40–100 demos per task; every mainstream VLA benchmark uses parallel grippers.
- 3. Egocentric video with action labels.** Video-only egocentric data is already a commodity (Egocentric-100K, raw footage resold for a few dollars an hour). What is scarce is measured hand and wrist pose, depth and coverage aligned to target skills —

the ingredients behind GR00T N1.7's 20,000-hour EgoScale pretraining and RDT2's 10,000 hours of UMI data.

4. **Humanoid motion and whole-body data.** The best open tracker (SONIC) was trained on 700 h of private mocap, the largest robot-ready set (BONES-SEED) is gated, and curation visibly pays: PHUMA's physics filtering and GMR's retargeting each move tracking success by double digits.
5. **Sim-ready assets and calibrated actuator models.** Menagerie misses most open humanoids and hands, every cheap-robot project builds its own system identification, and Gaussian-splat twins carry appearance but no physics.
6. **Neutral evaluation.** LIBERO is saturated, RoboChallenge is co-run by a model maker, RoboArena needs thousands of episodes, and no open benchmark exists for humanoid or five-finger manipulation. OpenArm built its Cell because cross-lab results do not compare.
7. **Data quality and format plumbing.** An audit found 81% of 100 public LeRobot datasets had issues; v2.1 → v3.0 conversions corrupt episodes; teams juggle MCAP, LeRobot, HDF5 and RLDS.

Who is already there: NVIDIA (Isaac Teleop for robot-free egocentric capture, Isaac Lab-Arena for environment generation, GRAIL data, Cosmos), Hugging Face (LeRobot's annotation pipeline, RoboChallenge), Lightwheel (sim assets plus EgoSuite), XDOF, Scale AI, Mecka AI, Build AI, Human Archive, Genesis AI (tactile glove), Bones Studio (mocap), Encord (curation), Luel (rights-cleared data) and Axis Robotics (crowdsourced sim teleop). Differentiation will have to come from sensors, quality assurance, rights and robot-specific alignment rather than raw volume or teleop software.

Stalled, archived or discontinued

Projects stall for three reasons: companies run out of money (K-Scale Labs), labs move on after the paper (most 2024 robot-learning repos), and platform owners retire tools (Isaac Gym, Habitat, ODrive's open firmware). Many are still worth reading or reproducing; few are worth building on.

Project	Category	What happened	Last real activity	Use instead
K-Scale Labs (K-Bot, Z-Bot, ksim)	humanoid company and software	Shut down Nov 2025 after failing to find a lead investor for its Series A; pre-orders refunded and IP released.	ksim v0.2.10 (Aug 2025); stray commits to Apr 2026	Berkeley Humanoid Lite, Asimov, Roboto Origin; mjlabs
AgiBot Lingxi X1 hardware	humanoid	Hardware files frozen; successor X2 is SDK-only; the training repo has no license file	Mar 2025	Roboto Origin, Asimov
Mobile ALOHA; original ALOHA repo	bimanual rigs	Stuck on ROS 1; Trossen carries the design commercially	2024	Trossen kits, OpenArm, XLeRobot, AlohaMini
TidyBot++	mobile base	Five commits after CoRL 2024	2024–25	LeKiwi, XLeRobot
Poppy Humanoid; ROBOTIS OP3	small humanoids	Last releases in 2020 and 2018 (OP3's model lives on in Menagerie)	2018–22	ToddlerBot, Open Duck Mini, Booster K1
Moss v1, BCN3D Moveo, Dummy, Berkeley Blue, Thor	arms	Deprecated or dormant; Dummy has no license at all	2016–2025	SO-101, reBot, PAROL6, AR4
DexHand V1.0, Yale OpenHand, Pisa/IIT SoftHand, Brunel Hand	hands and grippers	Dormant; mostly non-commercial licenses	2022–24	ORCA, Aero Hand Open, AmazingHand

Project	Category	What happened	Last real activity	Use instead
Meta DIGIT, TACTO, Sparsh	tactile	Repos archived; Sparsh is non-commercial	2021–25	9DTact, eFlesh, Digit 360 research units
ReSkin; AnySkin library	tactile	Code dormant (AnySkin is still sold)	2023–24	eFlesh, 9DTact
DexCap	hand capture	Dormant; depends on Rokoko gloves	Oct 2024	DexUMI, DOGlove
Open-TeleVision, Bunny-VisionPro, ACE, AnyTeleop	teleop	Dormant (only dex-retargeting from AnyTeleop is open)	2024	xr_teleoperate, VisionProTeleop, Isaac Teleop
ODrive open firmware	motor driver	v3 unmaintained; next-gen firmware closed under NDA	—	moteus
Isaac Gym	simulator	NVIDIA: "legacy... no longer supported"	Preview 4	Isaac Lab, mjlab
legged_gym, Humanoid-Gym	RL templates	Superseded by Isaac Lab ports	2024	Isaac Lab, mjlab, unitree_rl_lab
Habitat 3	simulator	Meta stopped development after v0.3.4	May 2026	ManiSkill3, BEHAVIOR-1K
PyBullet; Brax physics	simulators	Last PyBullet release Jan 2025; Brax keeps only its training library	2025	MuJoCo, MJX, MuJoCo Warp

Project	Category	What happened	Last real activity	Use instead
Holodeck, RoboGen, GenSim	scene and task generators	Dormant research code	2023–24	Infinigen, Isaac Lab-Arena, RoboCasa365
legged_control, OpenLoong-Dyn-Control	MPC + whole-body control	"Not supported anymore" / last version Sep 2024	2024	RL trackers; Pinocchio-based hybrids
HumanoidVerse, ASAP, HOVER, H2O/OmniH2O, PHC, GMT, HumanPlus	humanoid control	2024–25 paper repos without 2026 activity	2025	SONIC, BeyondMimic, holosoma, mjlalab
OpenVLA, Octo, CogACT, SpatialVLA, UniVLA, Magma, RDT-1B	VLAs	No updates in 2025–26; still cited as baselines	2024–25	OpenVLA-OFT, π 0.5, SmolVLA, X-VLA, RDT2
phosphobot	teleop app	No release since Oct 2025	Oct 2025	LeRobot + LeLab
RLDS	data format	Legacy Open X-Embodiment tooling	~2023	LeRobotDataset v3, MCAP

Methodology and sources

- **What counts as open:** design files, code or model weights published under a license that allows reuse; partially open projects (open software on closed hardware, non-commercial weights) are flagged. Closed products appear only as comparators.
- **Status rules (as of Oct 2, 2026):** Active = commits, releases, new hardware revisions, papers or shipping since about April 2026; Slowing = last dated activity 6–12 months ago; Dormant = over 12 months; Discontinued = officially ended or the company closed.
- **How it was gathered:** parallel research passes on Oct 2, 2026 over primary sources — GitHub repo and release pages, PyPI, Hugging Face model and dataset cards, arXiv papers, vendor pages and reputable press. The GitHub API was unavailable, so star

counts come from GitHub pages or a package index and are rounded, and status leans on release, PyPI and paper dates where commit dates were not visible.

- **Caveats:** vendor and author numbers are marked "self-reported"; benchmark results are mostly self-reported; Hugging Face download counts are rolling file requests that differ up to 30× between views; several Chinese projects develop on AtomGit or Gitee mirrors that were not fully checked; hardware unit sales are rarely published. Some pages were rate-limited, and facts seen only in search headlines are marked "reported".

Sources

Hardware and hands

- [Berkeley Humanoid Lite](#) · [ToddlerBot paper](#) · [Menlo Research: humanoid legs in 100 days](#) · [Roboto Origin coverage](#) · [K-Scale Labs shutdown](#) · [HopeJR announcement](#) · [Unitree G1](#)
- [LEAP Hand paper](#) · [ORCA v1](#) · [ORCA platform](#) · [RUKA](#) · [RUKA-v2](#) · [Aero Hand Open](#) · [RAPID Hand](#) · [Sharpa Wave listing](#)
- [UMI](#) · [FastUMI-100K](#) · [DexUMI](#) · [DOGlove](#) · [Taccel](#) · [Sparsh](#)

Arms and teleop

- [SO-101 launch \(TechCrunch\)](#) · [OpenArm](#) · [OpenArm 2.0 listing](#) · [reBot B601](#) · [GELLO paper](#) · [AgileX Piper](#) · [Trossen WidowX](#)

Models and benchmarks

- [openpi](#) · [Physical Intelligence \(Wikipedia\)](#) · [GR00T N1.7 card](#) · [NVIDIA forum on GR00T licensing](#) · [NVIDIA GTC 2026 robotics news](#)
- [OpenVLA-OFT](#) · [SmolVLA blog](#) · [Xiaomi-Robotics-0](#) · [MolmoAct2](#) · [AI2 MolmoAct2 blog](#) · [Gemini Robotics 2 coverage](#) · [Generalist GEN-0](#)
- [LIBERO-Plus](#) · [LIBERO-PRO](#) · [RoboChallenge report](#) · [RoboChallenge snapshot \(sota2\)](#) · [RoboArena](#) · [BEHAVIOR 2025 winner](#) · [BEHAVIOR Challenge](#) · [RoboTwin 2.0](#) · [ArmnetBench](#) · [AgiBot World Challenge 2026](#) · [World Humanoid Robot Games 2026](#) · [RoboCup 2026 results](#)

Whole-body control and motion data

- [SONIC](#) · [BeyondMimic](#) · [GMR: Retargeting Matters](#) · [holosoma paper](#) · [OmniRetarget](#) · [TWIST2](#) · [PHUMA](#) · [AMASS license](#) · [BONES-SEED](#)

Simulation

- [Isaac Lab report](#) · [Isaac Lab releases](#) · [Newton](#) · [MuJoCo](#) · [MuJoCo Playground](#) · [mjlab](#) · [ManiSkill3](#) · [GaussGym](#)

Tooling, datasets and the data market

- [LeRobot paper](#) · [LeRobot dataset analysis](#) · [LeRobot dataset lint audit](#) · [UMA and Rémi Cadène](#) · [Qualcomm acquires PickNik](#) · [EgoSuite-Open100K](#)
- [XDOF \(TechCrunch\)](#) · [Human Archive \(TechCrunch\)](#) · [DreamVu: robot data companies 2026](#) · [EXYLOS dataset pricing](#) · [DataX Power collection costs](#) · [Flikforge on the egocentric-video glut](#)