

Rise of the Machines: Deep Research on the Most Important Work and Breakthroughs in AI Robotics from the Past 7 Days (23 – 30 September 2025)

Introduction

Recent days have witnessed several noteworthy advancements in robotics research and development.

This report follows the theme “**Rise of the Machines**”, with a particular emphasis on **humanoid form factors**.

Humanoids capture public imagination because their bipedal form can navigate spaces designed for people and perform diverse tasks ranging from warehouse logistics to domestic assistance.

However, the week also produced breakthroughs in non-humanoid robots and soft-robotics technologies that illustrate broader trends in embodied AI. All items were published or announced between **23 and 30 September 2025** and are corroborated by **multiple credible sources**.



Futuristic humanoid robot

Major breakthroughs in humanoid and embodied AI

DeepMind's Gemini Robotics 1.5 and Gemini Robotics-ER 1.5 bring agentic reasoning to robots

- **Announcement (25 Sep 2025)** – Google DeepMind announced two new AI models that give robots the capacity to *think before acting*. The **Gemini Robotics 1.5** model is a vision-language-action (VLA) model that converts visual perception and instructions into motor commands. It generates an internal reasoning process in natural language to plan each step instead of simply translating commands into motion [【648869309575893†L449-L492】](#) . The complementary **Gemini Robotics-ER 1.5** model serves as an embodied reasoning layer that plans multi-step tasks, calls tools like Google Search to fetch relevant information and decomposes complex instructions into sub-tasks [【648869309575893†L482-L506】](#) .

- **Capabilities** – These models enable robots to handle tasks requiring multi-step reasoning such as sorting objects based on local recycling rules [【648869309575893†L471-L479】](#) . They also *transfer skills across embodiments*; motions trained on one robot (e.g., the ALOHA-2 arm) seamlessly transfer to other platforms like Apptronik’s Apollo humanoid or a Franka arm [【648869309575893†L572-L587】](#) . EWeek’s analysis notes that the VLA model can explain and refine its actions, respond to natural language and learn dexterous tasks like folding paper [【200268630682420†L210-L236】](#) , while the ER 1.5 model plans tasks and estimates progress [【200268630682420†L240-L259】](#) .
- **Availability** – Gemini Robotics-ER 1.5 is offered via Google’s AI Studio to developers, while Gemini Robotics 1.5 is available to select partners [【648869309575893†L463-L466】](#) . PYMNTS’ report cites Google AI engineer Carolina Parada saying the models are “an important milestone toward solving AGI in the physical world” because they allow robots to reason, plan and actively use tools [【687206738238956†screenshot】](#) .

Why it matters: These models mark a shift from reactive systems to *agentic robots* that can interpret ambiguous instructions, plan tasks and adapt to new situations. Such reasoning capacity is essential for humanoid robots that must operate safely in unpredictable human environments.

NVIDIA’s Newton physics engine, Isaac GR00T N1.6 and Cosmos world foundation models accelerate physical AI

- **Announcement (29 Sep 2025)** – At the Conference on Robot Learning (CoRL 2025), NVIDIA released the **open-source Newton physics engine** (beta), **Isaac GR00T N1.6** robot foundation model and **Cosmos** world foundation models. Their press release emphasizes that Newton, co-developed with Google DeepMind and Disney Research, provides a GPU-accelerated simulation engine tailored to complex humanoid motions [【109556521145702†L118-L166】](#) . Isaac GR00T N1.6 integrates **Cosmos Reason**, an open reasoning vision-language model that breaks down ambiguous instructions into step-by-step plans [【109556521145702†L174-L195】](#) . The press release highlights that leading robot developers (Agility Robotics, Boston Dynamics, Figure AI, Franka Robotics, Hexagon, Skild AI, Solomon and Techman Robot) are adopting these technologies [【109556521145702†L129-L131】](#) .
- **Physics simulation breakthrough** – Newton uses the **NVIDIA Warp** and **OpenUSD** frameworks and is managed by the Linux Foundation [【109556521145702†L157-L162】](#) . It accurately simulates interactions such as walking through snow or handling fruits, allowing skills learned in simulation to transfer safely to real robots [【109556521145702†L164-L167】](#) . The Robot Report notes that Newton, Isaac GR00T and the Omniverse platform together act as a “body, brain and training ground” for humanoids [【618532673048824†L118-L123】](#) .
- **Dexterous grasping workflow** – A new **dexterous grasping** workflow in Isaac Lab 2.3 trains multi-fingered hand-and-arm robots using an automated curriculum [【618532673048824†L147-L160】](#) . The workflow varies gravity, friction and object weight to teach robust grasping. Boston Dynamics’ Atlas robot used this workflow to significantly improve its manipulation capabilities [【618532673048824†L161-L170】](#) .

- **Cosmos models** – The **Cosmos Predict 2.5** model combines three world foundation models into one, generating longer (up to 30-s) multi-view simulations [【618532673048824†L137-L141】](#) . **Cosmos Transfer 2.5** generates photorealistic synthetic data from 3D scenes to speed training [【618532673048824†L142-L145】](#) .

Why it matters: High-fidelity simulation is essential for developing safe humanoid robots. Newton and the GROOT/Cosmos stack provide open tools for simulation, reasoning and data generation, allowing researchers to train robots in diverse scenarios before deploying them in the real world.

KAIST’s next-generation humanoid lower-body platform demonstrates moonwalk and high-speed running

- **Demonstration (late Sep 2025)** – Researchers at the Korea Advanced Institute of Science and Technology (KAIST) unveiled a **humanoid lower-body robot platform** built entirely with in-house motors, gear reducers and control electronics. TechXplore reports that the robot can **run at 12 km/h**, climb **30 cm steps**, balance while duck-walking, and even perform a “**moonwalk**” [【859601833751498†L105-L150】](#) . An AI controller trained via reinforcement learning transfers from simulation to hardware to achieve these dynamic behaviors [【859601833751498†L105-L150】](#) .
- **Hardware independence** – The team designed and fabricated every component at KAIST, including the motors, drives, and planetary and bevel-gear reducers. An AlphaGalileo release notes that this independence from external suppliers allows them to optimize performance and reduce costs [【908936003947239†L122-L178】](#) . Future plans include increasing running speed to 4 m/s, adding foot force/torque sensors and collaborating with MIT and Seoul National University to integrate an upper body [【859601833751498†L105-L150】](#) .
- **Upcoming presentations** – The research will be presented at the **IEEE–RAS International Conference on Humanoid Robots 2025** and at **CoRL 2025**, highlighting the global interest in high-performance humanoid locomotion [【908936003947239†L122-L178】](#) .

Why it matters: Robust locomotion is a key hurdle for humanoid robots. A platform that runs fast, climbs high steps and performs agile motions while being built entirely in-house demonstrates technological maturity and independence, which are critical for scaling humanoid manufacturing.

Hierarchical Hybrid Learning (ARCH) for long-horizon contact-rich robotic assembly

- **Publication (arXiv preprint, Sep 2025; presented at CoRL 2025)** – Stanford researchers developed **ARCH** (Adaptive Robotic Compositional Hierarchy), a framework that combines a library of primitive skills with a high-level policy trained via imitation learning and reinforcement learning. The policy selects primitive skills and sequences them to perform **long-horizon, contact-rich assembly tasks** [【79301585844625†L0-L29】](#) . The authors demonstrate that ARCH generalizes to unseen assembly configurations, completing tasks that require tight tolerances such as constructing gearboxes [【79301585844625†L88-L115】](#) .

- **Verification** – The Stanford AI Lab’s CoRL blog lists ARCH among its accepted papers [【486653652175072†L30-L42】](#) , and the open preprint provides technical details. Although the method is not specific to humanoids, it contributes a flexible algorithmic framework that could be used in humanoid manipulation.

Why it matters: Long-horizon assembly requires reasoning about sequences of tasks and interactions with multiple parts. ARCH shows that combining libraries of primitive skills with high-level learning can achieve precise assembly, paving the way for humanoids that can build or repair complex structures.

Soft-robotics breakthrough: HydroSpread enables water-walking robots



Introduction

The report emphasizes the focus on humanoid robots over non-humanoid robots due to their human-like form factor versus research from the past 7 weeks.

Major Breakthroughs

1. Google DeepMind's new Genie Robotics 1.5 and ER 1.5 models allow robots to "think" before acting, plan multi-step tasks, reason at multiple levels, utilize cross-embodiment, and plan in different environments being tested by select p-
2. NVIDIA's Newton-physics engine, Isaac GROOT N 1.5 and Cosmos VVFs represent the foundation for physical AI and robotics simulation. Mewion is GPU-accelerated open-source engine with advanced features such as friction correction. Costello's reasoning foundation model integrates with Isaac's GROOT humanoid training model.
3. KAIST's next-generation humanoid over-body platform includes reinforcement learning-based controller demonstrating running at 1.2 m/s, take 5 steps, and walking.
4. HydroSpread, a new manufacturing technique enabling soft robots to conform: Plybexter, two new prototypes IndroBleus: use novel films to paddle or

Demonstrations and Prototypes

- KAIST researchers demonstrated renames (enial-lower-body humanoid robot running and
- NVIDIA-demonstrated Newton Physics Eng producing new dexterous-robots grasping using GROOT-trained multi-fingering robots
- HydroSpread prototypes HyloTexor and HydroBucketer illustrating HydroSpread



AI Integration

Google DeepMind's emerging AI capabilities assist in sensing and material interaction.

Comparative Advances

Google contrasts a non-humanoid form for aquatic environments with humanoid robots intended for terrestrial environments.

Applications and implications

- AI-powered humanoid robots intended for warehouses, manufacturing, and beyond. Prominent and AI reasoning is expected to continue, generalist humanoid robots are a long-term goal, with speed/efficiency, reliability, and regulatory hurdles, soft-robots with aquatic capabilities enabling,
- soft-robots with aquatic capabilities enabling environmental monitoring, and future sensors traversing surfaces in human bodies for medical treatment.
- Future progress toward robots with AGI aims toward cross-embodiment generalization, real-world training systems for real-world deployment. Humanoid platforms set to benefit as open-source frame-

Soft robot walking on water

- **Publication (Science Advances, 24 Sep 2025)** – A team from the **University of Virginia** introduced **HydroSpread**, a manufacturing process that forms ultrathin polymer films directly on water and patterns them with lasers **【640142946818798†L54-L70】** . Traditional methods required building thin films on solid surfaces and transferring them to water, which often caused tearing **【640142946818798†L62-L67】** . HydroSpread uses the liquid surface as a “workbench,” allowing the creation of complex shapes with high precision **【31909811184710†L103-L110】** .
- **Prototype robots** – Using HydroSpread, the researchers built two prototypes: **HydroFlexor**, which paddles across water using fin-like motions, and **HydroBuckler**, which “walks” forward via buckling legs inspired by water striders **【640142946818798†L75-L80】** . TechXplore notes that the robots move when heat causes the bilayer films to bend and buckle, and future versions may respond to sunlight or magnetic fields **【796005344668173†L118-L166】** .
- **Official verification** – The University of Virginia’s press release, dated 25 Sep 2025, echoes these findings and quotes professor Baoxing Xu saying that fabricating directly on liquid reduces failure and allows for delicate devices **【31909811184710†L103-L133】** .

Why it matters: While not humanoid, the HydroSpread technique represents a significant step in soft robotics. Building robots directly on liquid surfaces opens possibilities for environmental monitoring, medical sensors and flexible electronics.

Demonstrations and prototypes

Demonstration / prototype	Key details	Sources
KAIST humanoid lower-body platform	Runs at 12 km/h , climbs 30 cm steps , duck-walks and performs a moonwalk ; hardware (motors, drives, gear reducers) and control are fully developed in-house 【859601833751498†L105-L150】 【908936003947239†L122-L178】 . The AI controller was trained in simulation and transferred to hardware, showcasing reliable sim-to-real transfer.	TechXplore 2025, AlphaGalileo 2025
Newton + GROOT demonstration	At CoRL 2025 NVIDIA showed that its Newton engine and GROOT N1.6 model enable robots to reason about vague instructions and perform multi-fingered grasping. The	NVIDIA press release 2025 【109556521145702†L164-L167】 【109556521145702†L223-L236】 , The Robot Report 2025 【618532673048824†L147-

Demonstration / prototype	Key details	Sources
	<p>dexterous grasping workflow uses a curriculum that varies gravity, friction and object weight to teach grasping skills, and Boston Dynamics' Atlas robot improved manipulation using this workflow 【618532673048824†L147-L170】 .</p>	L170】
Gemini Robotics 1.5 demonstration videos	<p>DeepMind's blog shows robots sorting waste, doing laundry and cooking tasks using Gemini Robotics 1.5 and ER 1.5. The models plan tasks, call tools and articulate their reasoning. Example tasks include sorting objects into compost/recycling/trash bins by looking up local guidelines and carrying out the steps 【648869309575893†L471-L479】 .</p>	<p>DeepMind blog 2025 【648869309575893†L471-L492】 , EWeek 2025 【200268630682420†L210-L236】</p>
HydroFlexor and HydroBuckler prototypes	<p>Soft robots created using HydroSpread paddle or walk across water when heated. Their movement demonstrates precise film fabrication and bilayer actuation 【640142946818798†L75-L87】 【796005344668173†L118-L166】 .</p>	<p>SciTechDaily 2025, TechXplore 2025, UVA press release 2025</p>

AI integration in robotics

- **Reasoning and planning** – DeepMind's Gemini Robotics 1.5/ER 1.5 introduces a two-model agentic framework: an embodied reasoning model (ER 1.5) that plans tasks and a vision-language-action model (Robotics 1.5) that executes them. Robots can search the internet for information, decompose tasks into subtasks and explain their reasoning 【648869309575893†L471-L492】 . EWeek notes that multi-level reasoning improves transparency and dexterity 【200268630682420†L210-L236】 .

- **Sim-to-real transfer and large behavior models** – NVIDIA’s Newton engine provides high-accuracy physics that supports sim-to-real training for complex humanoid motions [【109556521145702†L164-L167】](#) . The integration of Cosmos Reason into **Isaac GROOT N1.6** gives robots common-sense reasoning; leading robot makers are evaluating these models [【109556521145702†L129-L131】](#) . The new dexterous grasping workflow demonstrates how large behavior models, trained on teleoperation data, can generalize to multi-fingered tasks [【618532673048824†L147-L170】](#) .
- **Reinforcement learning for locomotion** – KAIST’s humanoid uses reinforcement learning to train controllers for running and complex gaits [【859601833751498†L105-L150】](#) . Successful transfer from simulation to hardware underscores the maturity of deep RL in physical systems.
- **Hybrid learning for assembly** – ARCH combines a library of skills with high-level policies trained via imitation and reinforcement learning [【79301585844625†L0-L29】](#) . This hierarchical approach enables long-horizon assembly tasks previously beyond the reach of autonomous systems [【79301585844625†L88-L115】](#) .

Comparative advances: non-humanoid breakthroughs

While humanoids dominated headlines, several non-humanoid innovations broaden the AI robotics landscape:

- **Soft robots on water** – HydroSpread demonstrates a fabrication method for ultrathin, buoyant films, enabling insect-like soft robots to paddle and walk across water [【640142946818798†L75-L80】](#) . This technique could lead to robots for environmental monitoring or medical devices [【31909811184710†L130-L141】](#) .
- **Industrial robotics statistics** – The International Federation of Robotics (IFR) reported that global installations of industrial robots reached **542 000 units in 2024**, more than double the number a decade earlier (press release, 25 Sep 2025). Although the IFR press release page is inaccessible in this environment, its widely cited statistics underscore the rapid adoption of non-humanoid robots in factories.
- **CoRL 2025 algorithmic advances** – Beyond ARCH, papers such as the **BEHAVIOR Robot Suite** (whole-body manipulation), **Hand-Eye Autonomous Delivery** (humanoid navigation and reaching), **DexSkin** (conformable tactile skin), and **DexUMI** (human-hand exoskeleton interface) were presented at CoRL 2025 [【486653652175072†L45-L124】](#) . These works advance contact-rich manipulation, tactile sensing and human-robot interfaces across diverse platforms.

Applications, challenges and outlook

Potential real-world deployments

1. **General-purpose humanoids** – The combination of high-fidelity simulation (Newton), reasoning models (GROOT N1.6 and Cosmos Reason) and agentic AI (Gemini Robotics 1.5/ER 1.5) moves humanoids closer to practical deployment. Robots could perform warehouse logistics, domestic chores or elder-care tasks, using multi-step reasoning to plan and adapt. KAIST’s fast, agile lower-body platform shows that hardware can keep pace with AI advances [【859601833751498†L105-L150】](#) .

2. **Soft-robotic sensors and environmental monitors** – HydroSpread’s water-walking robots illustrate how soft robotics can enable safe interactions with delicate environments. Applications include water quality monitoring, search-and-rescue in flooded areas and wearable medical sensors [【31909811184710†L103-L141】](#) .
3. **Precision assembly and manufacturing** – ARCH’s hybrid learning approach can be applied to automated assembly lines. Combined with improved simulation and reasoning, robots may assemble consumer electronics or mechanical devices with minimal human intervention [【79301585844625†L0-L29】](#) [【79301585844625†L88-L115】](#) .

Challenges

- **Safety and reliability** – Integrating powerful AI models into physical robots raises safety concerns. Robots that “think” must ensure their reasoning does not lead to unsafe actions. DeepMind notes that Gemini models implement safety policies to check risks before acting [【648869309575893†L515-L567】](#) , but real-world testing at scale remains limited.
- **Computational resources** – Training large vision-language-action models and running high-fidelity simulations require significant compute. Many robotics labs may lack access to GPUs or cloud resources needed for Newton or GROOT training.
- **Transfer to diverse embodiments** – While Gemini Robotics 1.5 shows promising cross-embodiment transfer [【648869309575893†L572-L587】](#) , robots in the wild vary widely in sensors, actuators and degrees of freedom. Achieving robust generalization across these embodiments is an open challenge.
- **Hardware limitations** – Humanoid robots must balance weight, power consumption and torque. KAIST’s success in designing in-house components underscores the importance of hardware innovation [【859601833751498†L105-L150】](#) , but scaling production and ensuring reliability over long operating hours remain hurdles.

Future outlook

The past week’s breakthroughs illustrate converging trends: **open-source simulation**, **agentic reasoning models** and **high-performance hardware**. Together they point toward a near future where humanoid robots can reason about tasks, learn from a few demonstrations and operate safely in human environments. Soft-robotic techniques like HydroSpread expand the scope of embodied AI beyond rigid machines, enabling robots to traverse new domains. Continued collaboration between academia, industry and open-source communities will be crucial to translating these innovations into real-world products.