# Bodies, not just brains: why the next leap in humanoid robots must be mechanical



Watch the viral videos and it is tempting to conclude the robot revolution is already here: humanoids vaulting, folding shirts and loading washing machines. Yet beneath the spectacle a growing chorus of engineers and researchers says the problem is not the software but the bodies those brains are trying to animate. Sony’s research programme, for example, has explicitly flagged the “limited number of joints” in today’s humanoids and is calling for work on “flexible structural mechanisms” to enable genuinely dynamic motion. According to that call, smarter, more adaptive physical architectures are needed before the machines can realise their promise. (Sony’s funding initiative invites universities and labs to propose cross‑disciplinary projects aimed at those exact shortcomings.) [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html)[[2]](https://www.sony.com/en/SonyInfo/research-award-program/)

At the heart of the debate is a familiar trade‑off: robots built around a “brain‑first” model must rely on heavy computation and powerful actuators to correct for bodies that do not help themselves. That approach is inefficient. Recent coverage singled out figures that capture the scale of the mismatch — noting, for example, that one commercial prototype consumes roughly 500 watts just to walk, while a human on a brisk walk uses around 310 watts — and argued that rigid, sensor‑poor limbs force machines to expend energy to overcome their own inertia. Theoretical work on morphological computation explains why this matters: bodies can, by design, take on part of the control problem, stabilising motion and pre‑processing physical interactions so controllers need do less work. [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html)[[4]](https://direct.mit.edu/artl/article/23/1/1/2858/What-Is-Morphological-Computation-On-How-the-Body)

The result is diminishing returns from ever‑bigger neural models and more elaborate vision stacks. High‑profile demonstrations have themselves become a focal point for sceptics. When Tesla shared footage of Optimus folding a shirt, commentators quickly pointed out staged elements and gaps in autonomy; Business Insider reported that Elon Musk later acknowledged the action was “not yet” autonomous and that demonstrations can involve teleoperation or staged assistance. Such episodes underline the gap between polished showreels and robust, general‑purpose manipulation in messy, unpredictable environments. Industry observers warn that impressive demos do not yet equate to dependable real‑world capability. [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html)[[6]](https://www.businessinsider.com/reactions-tesla-robot-folding-shirt-question-video-real-2024-1)

Nor do the acrobatic reels tell the whole story for established research platforms. Boston Dynamics’ all‑electric Atlas has been redesigned to trade hydraulics for electric actuation and showcases an extraordinary range of motion, but even the company’s own evolution illustrates the point: Atlas remains a research prototype rather than a commercial worker. Reporting on the April 2024 reveal stressed that the viral routines mask continuing limitations — from energy and autonomy to the lack of tactile, conforming feet — that make confident, everyday operation on uneven, natural terrain elusive. [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html)[[7]](https://www.bbc.com/news/articles/ck7ly07gmx4o)

That practical shortfall is precisely what the emerging field of mechanical intelligence (MI) is trying to address. Researchers at London South Bank University’s MI Research Group, led by Hamed Rajabi, translate biomechanics and adaptive‑structure ideas into compliant mechanisms, soft–rigid hybrids and energy‑storing elements that embed “passive” intelligence into the body itself. The principle is old and well documented in robotics literature: morphological computation shows how structures — a pine cone’s humidity‑driven scales, a hare’s elastic tendons, a human fingertip’s soft flesh — can perform useful, automatic responses to the world without expensive sensing or control. Rajabi and colleagues argue that incorporating those lessons into humanoid design would let the controller do higher‑level tasks while the body handles local adaptation. [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html)[[3]](https://www.lsbu.ac.uk/research/centres-groups/mechanical-intelligence-mi-research-group)[[4]](https://direct.mit.edu/artl/article/23/1/1/2858/What-Is-Morphological-Computation-On-How-the-Body)

There are already practical precedents for the gains MI promises. MIT’s legged‑robot work — exemplified by the Cheetah project — demonstrates how tendon‑like elements, low‑inertia limbs and energy‑regenerative control can yield a cost of transport comparable to animals and markedly extended operating time. Other academic teams are producing hybrid hinges and compliant joints that combine precision with shock absorption, which could let shoulders, knees and hands move with multiple degrees of freedom without constant active correction. These projects suggest that, when mechanical design and control are co‑optimised, robots can become both more capable and more energy‑efficient. [[5]](https://news.mit.edu/2013/mit-cheetah-robot-0308)[[3]](https://www.lsbu.ac.uk/research/centres-groups/mechanical-intelligence-mi-research-group)[[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html)

So why haven’t the industry giants pivoted hard towards MI? Partly because today’s market leaders are rooted in software and electronics ecosystems that favour high‑precision motors, sensors and processors — the very components a brain‑centric strategy exploits. Building mechanically intelligent bodies at scale demands different materials, new manufacturing chains and cross‑disciplinary partnerships that the sector’s supply networks are not yet structured to deliver. Sony’s awards programme and similar initiatives are attempts to bridge that gap by funding collaborations between manufacturers, materials scientists and roboticists to move compliant, adaptive structures from lab curiosity to industrial reality. [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html)[[2]](https://www.sony.com/en/SonyInfo/research-award-program/)

The implication for the next phase of robotics is clear: progress will be less about choosing hardware over software and more about making them co‑equal partners. As Hamed Rajabi wrote in his analysis, the pathway out of the current humanoid trap involves bodies that shoulder some of the computation — leaving AI to focus on strategy, learning and complex interactions. Researchers and funders are already taking tentative steps in that direction, but turning prototypes and academic proofs into reliable, mass‑manufacturable systems remains the enduring engineering and industrial challenge. Until that synthesis is achieved, the epochal promise of humanoid robots stepping fully into everyday life will remain a work in progress. [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html)[[3]](https://www.lsbu.ac.uk/research/centres-groups/mechanical-intelligence-mi-research-group)[[4]](https://direct.mit.edu/artl/article/23/1/1/2858/What-Is-Morphological-Computation-On-How-the-Body)[[2]](https://www.sony.com/en/SonyInfo/research-award-program/)

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* Paragraph 1 – [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html), [[2]](https://www.sony.com/en/SonyInfo/research-award-program/)
* Paragraph 2 – [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html), [[4]](https://direct.mit.edu/artl/article/23/1/1/2858/What-Is-Morphological-Computation-On-How-the-Body)
* Paragraph 3 – [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html), [[6]](https://www.businessinsider.com/reactions-tesla-robot-folding-shirt-question-video-real-2024-1)
* Paragraph 4 – [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html), [[7]](https://www.bbc.com/news/articles/ck7ly07gmx4o)
* Paragraph 5 – [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html), [[3]](https://www.lsbu.ac.uk/research/centres-groups/mechanical-intelligence-mi-research-group), [[4]](https://direct.mit.edu/artl/article/23/1/1/2858/What-Is-Morphological-Computation-On-How-the-Body)
* Paragraph 6 – [[5]](https://news.mit.edu/2013/mit-cheetah-robot-0308), [[3]](https://www.lsbu.ac.uk/research/centres-groups/mechanical-intelligence-mi-research-group), [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html)
* Paragraph 7 – [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html), [[2]](https://www.sony.com/en/SonyInfo/research-award-program/)
* Paragraph 8 – [[1]](https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html), [[3]](https://www.lsbu.ac.uk/research/centres-groups/mechanical-intelligence-mi-research-group), [[4]](https://direct.mit.edu/artl/article/23/1/1/2858/What-Is-Morphological-Computation-On-How-the-Body), [[2]](https://www.sony.com/en/SonyInfo/research-award-program/)

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## Bibliography

1. <https://www.independent.co.uk/tech/robots-ai-design-flaw-boston-dynamics-tesla-b2805362.html> - Please view link - unable to able to access data
2. <https://www.sony.com/en/SonyInfo/research-award-program/> - Sony's Research Award Program is an open‑innovation funding initiative that invites universities and research institutions to submit proposals across AI, sensing, devices and related fields. Running annually in regions including North America, Europe and India, it offers Faculty Innovation and Focused Research awards (up to US$100k and US$150k respectively) to support collaborative projects with Sony research teams. The 2024/2025 calls expanded themes towards AI, content creation and device technologies; notably, Sony listed topics such as 'Flexible Structural Mechanisms Enabling Dynamic Motion Entertainment', signalling interest in mechanical and materials innovations for robotics and adaptive structures, and cross‑disciplinary manufacturing partnerships at scale.
3. <https://www.lsbu.ac.uk/research/centres-groups/mechanical-intelligence-mi-research-group> - London South Bank University's Mechanical Intelligence (MI) Research Group, led by Dr Hamed Rajabi, researches bio‑inspired structural design that embeds passive, adaptive behaviours into engineered systems. The group explores biomechanics, adaptive structures, bioinspired drones and compliant end‑effectors to reduce reliance on active sensing and control, translating natural mechanisms into efficient robotic and architectural solutions. MI aims to harness morphological computation principles — using structure and materials to perform tasks that would otherwise demand power and computation — advancing soft–rigid hybrid mechanisms, adaptive hinges and energy‑storing elements to improve resilience, efficiency and multifunctionality in real‑world applications across engineering and manufacturing.
4. <https://direct.mit.edu/artl/article/23/1/1/2858/What-Is-Morphological-Computation-On-How-the-Body> - The article 'What Is Morphological Computation?' examines how an agent's physical form contributes to control and cognition by performing computation through morphology. It surveys classic cases — passive dynamic walkers, elastic structures, gecko adhesion and soft bodies acting as reservoirs — and discusses how structure, material properties and passive dynamics can pre‑process information or stabilise behaviour, thereby offloading tasks from nervous systems or controllers. The paper clarifies competing definitions of 'computation' in this context, presents frameworks to identify morphological computation, and argues that exploiting body–environment interactions can simplify control, reduce energy use and inspire more robust robotic designs.
5. <https://news.mit.edu/2013/mit-cheetah-robot-0308> - MIT's 'Cheetah' robot project, led by Sangbae Kim, developed electrically driven legged robots that mimic biological elasticity to achieve remarkable locomotion efficiency. Using custom high‑torque, low‑loss motors, tendon‑like Kevlar elements and energy‑regenerative control, the robot can trot at several miles per hour for extended periods while recovering impact energy back to batteries. Tests showed a low cost of transport comparable to animals and improved performance over hydraulic designs. The team emphasised motor design, reduced gearing and low leg inertia as keys to efficiency, demonstrating how mechanical design plus control can markedly lower energy consumption in running robots in practical field deployments.
6. <https://www.businessinsider.com/reactions-tesla-robot-folding-shirt-question-video-real-2024-1> - Business Insider reported widespread scepticism after Elon Musk posted a short video showing Tesla's Optimus appearing to fold a shirt. Observers spotted a gloved hand in the frame and criticised the lack of autonomy; Musk later clarified the action was 'not yet' autonomous and suggested teleoperation or staged assistance. The article notes Optimus prototypes have demonstrated basic movements previously, but cautions that scripted demonstrations do not yet reflect robust, general‑purpose manipulation in unconstrained environments. Coverage highlighted the gap between impressive hardware showreels and reliable autonomous behaviour for handling soft, crumpled objects and emphasised continuing challenges in tactile sensing and adaptation.
7. <https://www.bbc.com/news/articles/ck7ly07gmx4o> - The BBC reported on 17 April 2024 that Boston Dynamics retired its hydraulic Atlas humanoid after eleven years and unveiled a new all‑electric Atlas prototype. Coverage described the electric design as offering a broader range of motion and greater dexterity, replacing hydraulics with electric actuators to improve strength and controllability. The piece noted Atlas remains a research platform rather than a commercial product, emphasising limitations such as tethering in earlier versions, energy and autonomy challenges, and the difficulty of translating viral acrobatics into generalised, tactilely aware performance in unpredictable real‑world environments, and called for advances in sensing, materials and compliant design.