Australia's National
Science Agency

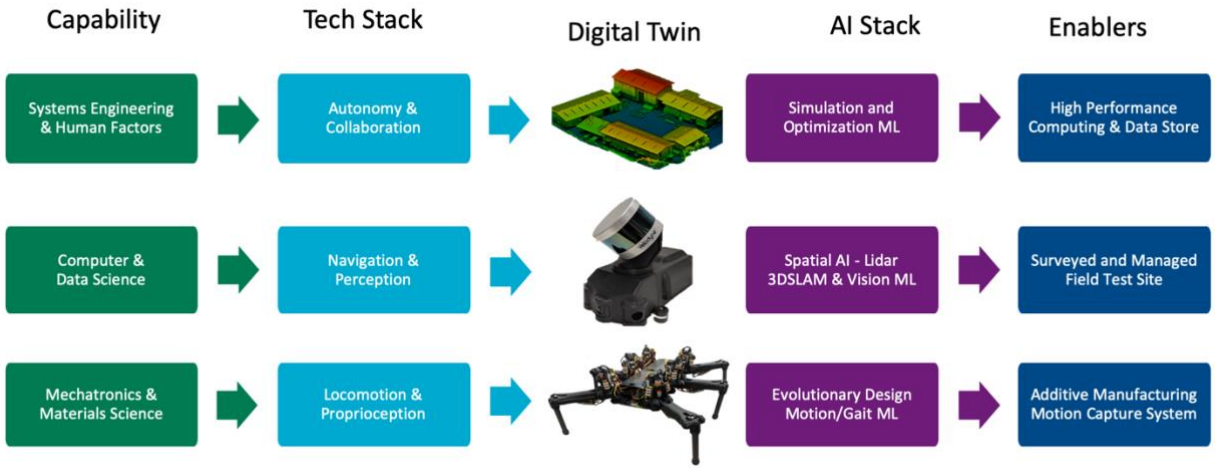
Next Generation AI-Enabled Robotics

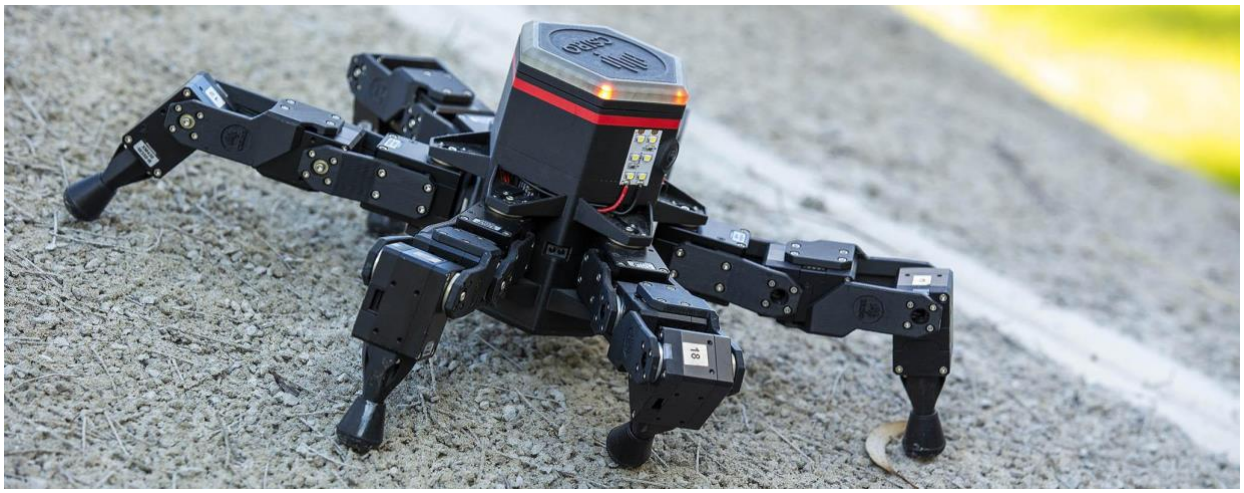
CSIRO Data61's RASG (Robotics and Autonomous Systems Group) is one of the world's leaders in field robotics research, with capabilities ranging from the development of unmanned aerial, underwater and ground vehicles, to multi-legged robots. Our robots are able to navigate through dynamic unstructured environments and operate in remote locations for extended periods of time: including the inspection and mapping of underground mines, monitoring biodiversity in the Amazon rainforest, inspection of remote assets for the mining and resource industry, evaluation of the health and yields of plants in horticulture, and assist emergency responders with exploration of damaged structures.

Whilst, we have been living with AI-enabled robots for more than 60 years (a robot is a machine that is able to sense, plan and act) the intelligence is codified into a hard set of rules. In the 1970s, robots started to use fuzzy rules - fuzzy logic - but still the behaviour of the robots was procedural. Today, with advances in machine learning (ML), the next generation of robotics will see a shift from automation (predefined behaviour) to autonomy (self-learning).

This will have a profound effect upon each layer of the robotics technology stack:

- Locomotion (the physical structure of the robot). Here we can use evolutionary learning to design robots that are optimal for their chosen environment (bespoke robotics) which is enabled by advanced manufacturing production (new materials and additive manufacturing).
- Proprioception (where the robot is aware of its own state). Here we can use Machine Leaning (ML) for gait or motion optimization, which is enabled by state-of-the-art Motion Capture Systems.
- Perception (where the robot is aware of its surrounding environment). Here we can use Lidar SLAM and Vision-based ML to build real-time 3D maps, which is enabled by surveyed and managed test facilities.
- Navigation (where the robot is able to move safety through the environment). Here we can use advances in Spatial AI (situational awareness) which is enabled with dedicated standards-based test facilities.
- Autonomy (where the robot is able to perform a required task). Here we can use extensive simulation and predictive modelling (Governance, Risk Analysis) which is enabled by High Performance Computing.
- Collaboration (where the robot is able to work with people or other robots). Here we can use advances in UX and Multi-Agent Learning, which is enabled by access to secure and trustworthy data storage.





Data61's hexapod, Gizmo, draws inspiration from nature and can be used to inspect confined spaces.

The Challenge

The robotics and autonomous systems sector is set to be worth $23 billion by 2025. Australia's robotics opportunity lies in developing and deploying robots and sensors, underpinned by artificial intelligence, to capture information about complex environments and automate tasks that would otherwise be completed by humans in high risk situations and at greater cost.

The Response

Data61's Robotics Innovation Centre, a national asset located in Queensland, allows robotics and machine-learning researchers to combine their expertise with ours and expand the much-needed collaboration between industry, government and academia. Our significant portfolio of robotics background intellectual property, such as hardware designs and software stacks can be leveraged to accelerate systems development and drive scientific discoveries through to commercial endeavours. We are uniquely positioned to leverage the extensive technical and domain expertise within CSIRO and across our network of industry, government and academic partners and we are actively seeking partners to discuss collaborative opportunities.

The Impact

Our Robotics Innovation Centre was launched in 2019 and is well positioned to assist technology developments to benefit industries of strategic importance to Australia and the world, such as manufacturing, agriculture, mining, and biodiversity. We have developed foundational and applied research to provide scientific, social and economic benefits through cutting-edge science, increased productivity and human safety, and augmentation of human capabilities. Our scientific achievements have already resulted in two spin-off companies: Emesent, a drone autonomy company, and RapidAIM, which is revolutionising pest monitoring around the globe. We also have commercial partners such as CSIRO's joint-venture GeoSLAM, which has commercialised our SLAM technology.

What's Next

We are actively seeking partners to discuss further opportunities for collaborative projects and shared use of our state-of-the-art robotics infrastructure to better position Australia as a world-leader in the creation and adoption of field robotics.

As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.
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