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17 September 2025

Engineering Validation Confirms Transformational Potential of RRAM Robotics Reflex Platform

On-Chip Neural Network Validated for Real-Time Reflex Decisions

Key Highlights:

- **Sub-microseconds array latency per reflex decision:** Engineering analysis confirms dorsaVi's RRAM-array can perform neural inference operations in **≤0.8µs**, enabling biological-grade reflexes, shifting focus towards ADC/sense-amps/row-drivers and actuator mechanics to meet ≤ 1 ms command targets.

- **Picojoule (pJ) array conduction efficiency:** Each reflex operation consumes just **~13–127 pJ** under compact Multi-Layer Perceptron (MLP) design consists of 64 input and 16 hidden neurons with 2 outputs, i.e., "Hold" and "Tighten".

- **Binary writes < 200 pJ/bit supports nanojoule (nJ) typical event logs**: The design allows recalibration events occurring in the nanojoule range, supporting continuous adaptation in low-power, battery-constrained environments.

- **Flash memory limitations for reflex applications:** NAND is unsuitable for reflex-class updates and in-memory computation, while embedded NOR cannot support frequent, low-energy writes and in-array compute.

- **Commercial translation enabled by RRAM**: These performance metrics allow the Reflex Platform to move from concept to deployment in robotic grippers, prosthetic limbs, exosuits, and next-generation HMIs, where speed, adaptability, and energy efficiency are paramount.

- **Strategic milestone reinforces deep-tech roadmap**: This validation strengthens the Company's strategic direction and positions dorsaVi as a future leader in neuromorphic robotics, adaptive motion platforms, and embedded biosignal AI.

- Results from the Company's ongoing robotic evaluation program, focused on soft grippers, AMRs, and exosuits to be reported imminently.

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Melbourne, Australia, 17 September 2025: dorsaVi Limited (ASX:DVL) (dorsaVi or the Company) is pleased to announce a major technical milestone, with the successful engineering validation of its RRAM-powered Reflex Platform**,** confirming its potential to deliver biological-grade reflexes at unprecedented speed and energy efficiency.

Reflex decisions need to be made within ≲1 ms in wearables and grippers; our engineering analysis confirms that a complete neural reflex decision can be executed on the in-memory RRAM crossbar array in ≤0.8 µs with ultra-efficient energy consumption in pJ range. These breakthrough results confirm the memory element is no longer the bottleneck, shifting focus to peripheral circuitries and actuators. They also further validate the transformational potential of dorsaVi's Reflex Platform for next-generation robotics and biomedical applications, marking a critical milestone in the Company's mission to extend human movement into intelligent machines via its Artemis Labs innovation program[1].

Neural Reflex Engine Powered by In-Memory RRAM

DorsaVi's engineering team has completed device-array conduction floor validation based on compact feed-forward neural network in the form of Multi-Layer Perceptron (MLP) utilizing RRAM as a binary synapse on its Reflex Platform, confirming the synaptic array ability to perform complete neural reflex decisions directly within memory at pJ energy range and sub- µs latency per decision.

By implementing a compact, binary-weight MLP, designed specifically for safety-critical classification tasks like "tighten vs hold" in robotic grippers or prosthetic control, the Company has demonstrated that its Reflex Platform can meet or exceed the performance thresholds required for biological-grade reflexes. This milestone firmly establishes dorsaVi's hardware as a viable path to enabling fast, energy-efficient decision-making in advanced robotics, wearables, and human–machine interface systems.

The key findings are summarised below:

Array Conduction Floor Metric	RRAM-Enabled Reflex Platform	Implication
Reflex Decision Latency	≤ 0.8 microseconds	Exceeds biological reflex requirements; enables near-instantaneous response
Energy per Reflex Decision	~13–127 picojoules	Ultra-low energy use supports battery-powered, always-on devices
Calibration/Adaptation Energy	Nanojoule-class	Allows real-time learning and reconfiguration without draining power
System Bottlenecks	Not memory-bound (RRAM validated)	Limits shift to external components (sensors, ADCs, actuators)

These results confirm that RRAM is no longer the limiting factor in achieving biological-grade sub-ms reflexes systems. The performance ceiling now shifts to external components in the signal chain such as sensors, signal converters, and mechanical actuators. This marks a significant step forward

[1] Refer to ASX Announcement dates 20 August 2025

for practical deployment of reflex-grade AI in robotics, prosthetics, and human-machine interface systems.

Detailed Technical Insights

dorsaVi's engineering team deployed a **compact binary-weight MLP model** mapped to a tiled RRAM array, executing a full **matrix-vector multiplication (MVM)** per decision cycle. This architecture was chosen to mirror real-world use cases such as slip detection in robotic grippers, reflexive joint control in prosthetics, and EMG-driven adaptation in exosuits.

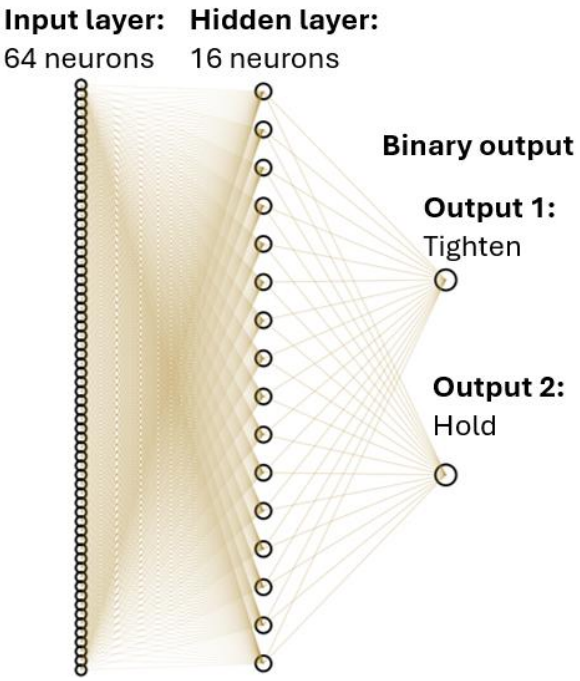

Figure 1 to illustrate the reflex-classifying neural network used in dorsaVi's RRAM-Enabled Reflex Platform, a compact MLP deployed on a 64×64 RRAM array to enable real-time decisions between "Tighten" and "Hold" reflex actions.

The model architecture included:

- **64-Dimensional Input** derived from 8 EMG channels × 8 IIR (incremental) features
- **One hidden layer with 16 neurons**
- **2 binary output nodes** to represent motor commands (e.g., "tighten" vs. "hold")

Using this configuration:

- Reflex decisions were completed within **≤0.8 µs** total array time.
- Power usage per inference was measured between **~13 to 127 pJ**.
- Updates to the configuration required energy in the **nanojoule range**, allowing learning without meaningful power drain.
- Total bit usage remained compact, occupying **just over 1,050 bits**, validating feasibility for edge integration.

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Legacy Flash Memory: A Critical Bottleneck for Reflex AI

Commodity NAND flash is page/block-oriented and has page-read latencies in the tens of microseconds (≈25–100 µs), with program/erase in the hundreds of microseconds to milliseconds. That granularity and latency make NAND ill-suited as working memory or for in-memory compute in sub-millisecond reflex loops. NOR/eFlash delivers tens-of-nanoseconds reads but incurs nJ-class per-bit program/erase energy and limited endurance (~10k–100k P/E), restricting frequent online updates. NAND endurance also varies widely (≈100k P/E for SLC down to a few-k for TLC), making it poor for high-frequency writes. In short, conventional Flash is appropriate for code storage and infrequent parameter updates, but not for always-on, adaptive control paths where decisions must be issued within ≤1 ms.

By contrast, dorsaVi's RRAM-based architecture performs neural computations directly within memory, achieving nanosecond-class response times and ultra-low energy use (~13–127 pJ per decision). This unique in-memory compute capability positions RRAM as the only viable memory technology to deliver biological-grade reflexes in wearable, autonomous, and safety-critical systems.

Enabling the Reflex Platform: From Concept to Real-World Systems

The validation findings confirm that dorsaVi's RRAM-enabled Reflex Platform is not just theoretically viable, but it is ready for integration into real-world robotic and biomedical systems, unlocking capabilities that were previously unattainable with conventional memory architectures.

Key Application Domains:

Application	Enabled Capability with RRAM Reflex
Robotics	Robotic grippers and collaborative systems can now execute biological-like slip reflexes, instantly tightening grip before object loss. Ideal for precision handling in unpredictable environments.
Prosthetics & Exosuits	EMG-responsive limbs and assistive suits can continuously adapt to biosignals with negligible power consumption delivering support in real-time without draining batteries.
Human–Machine Interfaces	Wearable devices and HMIs become always armed and instantly responsive, improving safety, reliability, and interaction quality in clinical, industrial, and defence scenarios.

Gernot Abl, Chairman of dorsaVi, said: "We are incredibly proud to share the validation results of our RRAM-enabled Reflex Platform, which confirm its readiness for sub-millisecond, energy-efficient reflex control in real-world applications. These outcomes mark a pivotal milestone for dorsaVi as we advance beyond traditional sensor technologies toward neuromorphic systems that can think, adapt, and respond in real time. As we continue to commercialise this breakthrough, our focus remains on high-impact domains where reliability and energy efficiency are mission-critical."

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About dorsaVi

dorsaVi Ltd (ASX: DVL) is an ASX company focused on developing innovative motion analysis device technologies for use in clinical applications, elite sports, and occupational health and safety. dorsaVi believes its wearable sensor technology enables, for the first time, many aspects of detailed human movement and position to be accurately captured, quantified, and assessed outside a biomechanics lab, in both real-time and real situations for up to 24 hours. dorsaVi's focus is on two major markets:

- **Workplace:** dorsaVi enables employers to assess risk of injury for employees as well as test the effectiveness of proposed changes to OHS workplace design, equipment or methods based on objective evidence. dorsaVi works either directly with major corporations, or through an insurance company's customer base with the aim of reducing workplace compensation and claims. dorsaVi has been used by major corporations including London Underground, Vinci Construction, Crown Resorts, Caterpillar (US), Boeing, Monash Health, Coles, Woolworths, Toll, Toyota, Orora, Mineral Resources and BHP Billiton.

- **Clinical:** dorsaVi is transforming the management of patients with its clinical solutions (ViMove+) which provide objective assessment, monitoring outside the clinic and immediate biofeedback. The clinical market is broken down into physical therapy (physiotherapists), hospital in the home and elite sports. Hospital in the home refers to the remote management of patients by clinicians outside of physical therapy (i.e. for orthopaedic conditions). Elite sports refer to the management and optimisation of athletes through objective evidence for decisions on return to play, measurement of biomechanics and immediate biofeedback to enable peak performance.

Further information is available at www.dorsaVi.com