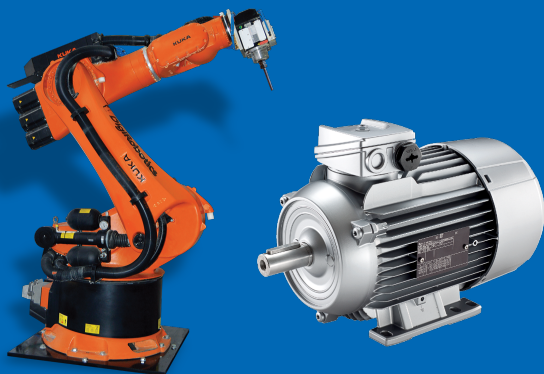




Imperial College
London

Industrial AI

Using FPGA based AI to empower the next generation of algorithms for industrial motor control.



A need for efficient control



There are approximately 8 billion electric motors in use in the EU alone, globally they account for around 47% of total energy consumption^[1].



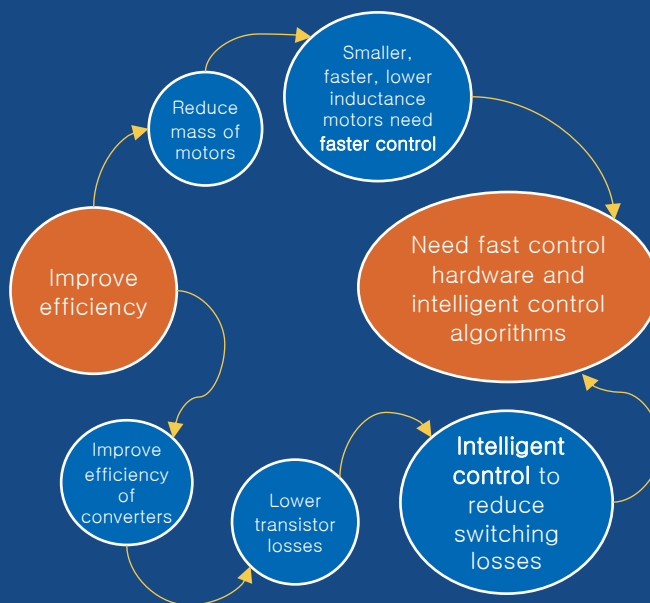
The industrial sector is responsible for over 60% of the electricity consumption by motors worldwide^[2].



Globally, total demand for energy use in motor systems is expected to double by 2040^[2].



There is clearly a need for more efficient motor systems in industry. This need is driving the push towards faster and more efficient control hardware.



Sources: [1] European Commission 2021, https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/energy-efficient-products/electric-motors_en [2] 'Infographic: The Profile of Energy Use in Industrial Motor Systems', Global Energy Intelligence, 2017.

Benefits of faster control

Faster control enables industrial robots to move with greater speed. This equates to a faster production line, and therefore a higher potential output over time.



Faster control also improves the safety of collaborative robots that operate in the same environment as humans, thanks to quicker responses.

Why FPGAs?

Intel® FPGA devices offer the performance, flexibility and connectivity necessary to enable better control, all with lower energy consumption than conventional microcontrollers.

High Frequency Control Algorithms

Low latency makes faster control loops (50+ kHz).

Multi-axis control

Parallelism & high throughput offer the potential for fully synchronised control over 4+ axes.

Improved Integration

Intel® FPGAs enables you to combine different sensors. Providing external capabilities without requiring extra chips, reducing part counts.

Reprogrammable, Customizable

The reconfigurable nature of FPGAs make them ideal for seamless updates and improvements.

Our Concept



We have developed an intelligent motor speed controller



Our controller harnesses the power of **Neural Networks** trained with cutting-edge **Reinforcement Learning** techniques



Our controller is available as IP for deployment on Intel® **FPGA** hardware targets



The controller outperforms traditional controllers with a faster control response and better energy efficiency

Why neural networks?

Nonlinearity

A neural network controller can outcompete conventional linear control devices with faster response



Complexity

Neural networks solutions can scale to handle multi-motor drive problems that would be too complex for conventional controllers

Optimisation

Neural networks can be trained to optimise for energy efficiency and speed



Using AI to beat the competition



90% of industrial control loops use simple PID control which our solution can outperform in both speed and efficiency.



Even advanced optimal control methods such as MPC require solving real-time optimisation problems – this iterative process is slow and does not scale to complex control problems.

Our neural network can be trained offline before it is deployed. A single pass through the trained network is much faster than solving a real time optimisation problem.



Price Competitive

Our improved controller performance, combined with Intel® Max® 10 FPGAs, starting at just \$16.74 USD^[4] make an ideal low-cost solution for industrial control.



Source: [3] https://www.cappgemini.com/wp-content/uploads/2017/05/dti-smart-factories-full-report-rebranded-web-version_16032018.pdf [4] <https://buyfpga.intel.com> [5] <https://www.intel.com/content/www/us/en/programmable/buy/design-software.html>

Future Market: Smart Factories and beyond

Smart Factories are combining modern connectivity technologies such as 5G with AI to drive the shift towards increased automation.



At least 76% of manufacturers are already pursuing a Smart Factory initiative, as part of a movement worth up to \$1.5 trillion USD globally^[3].

Innovative new AI technologies such as our own are helping lead the change in modern manufacturing techniques, electric vehicles, appliances and HVAC systems.



Intel® Quartus Prime®

Implementing our AI Control design on your existing FPGA control hardware has never been easier. Using Intel® Quartus Prime®, simply use our pre-built IP blocks which come with your standard license. Now everyone can have access to a more intelligent control system.

A Fixed 1-year subscription to Intel® Quartus® Prime Pro Edition software starts at \$3,995 USD^[5]. Intel® Max® 10 FPGAs, are available from \$16.74 USD^[4].



For more information regarding pricing or how the product can help your business create more efficient and faster motor control, contact our team at industrialAI@intel.imperial.com.