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TECHNOLOGY TRANSFER PROGRAMME

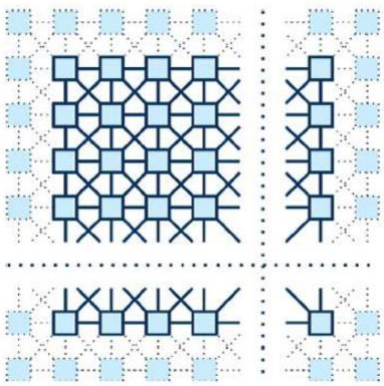
Cellular Neural Networks (CNNs) for data processing

The renowned Università di Catania has developed a hardware system for real-time image processing in the JET tokamak. Based on the Falcon architecture, the Cellular Neural Networks (CNN) implementation relies on a hardware system with intrinsic parallelism that can provide real-time data processing with deterministic and constant computational times. The CNN paradigm emulates the behaviour of optic nerves in living creatures and is ideal for applications such as video surveillance, medical imaging devices, and vision-assisted intelligent robots.

Description of the technology

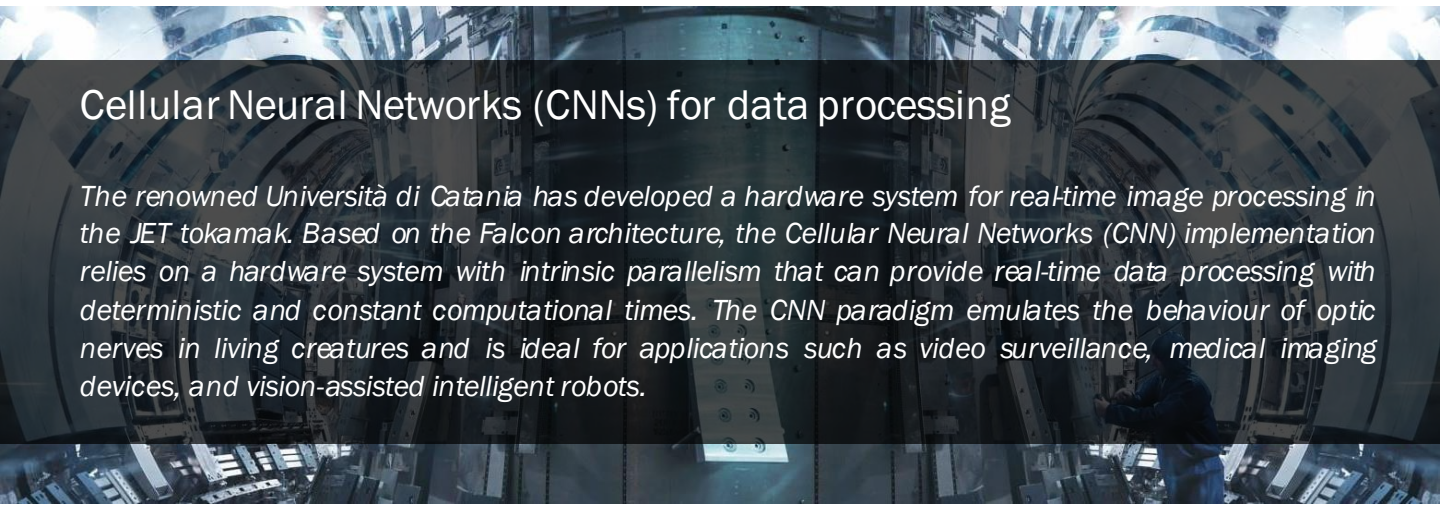
The Università di Catania in Italy has developed a hardware–based system for real– time data processing. The system developed uses CNNs implemented on field-programmable gate arrays (FPGAs) to provide deterministic and constant computational times e.g. on a millisecond timescale for 8-bit 496×560 images. The FPGA-CNN system has been tested in the JET tokamak for a hot spot recognition application and is found to be competitive with both traditional software algorithms and DSP--CNNs. Real–time image processing is essential for many applications including video surveillance, industrial visual inspection systems, medical imaging devices, and spectral imaging systems.

Applying the sorting algorithm to hot spot recognition in the JET tokamak Left: original image from IR camera. Centre: threshold--based image with three different shades. Right: the final processed image; each rectangle separates the hot regions(courtesy of Palazzo et al)



CNN array and virtual cells, shown in lighter shade (courtesy of Palazzo et al)

The CNN architecture is a real–time data processor (not just an image processor) and modern applications include modeling of neural networks for biological motion, vision, and higher brain function. CNN–based processors are now being integrated with sensors and actuators in order to expand the application domains of the technology.



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Innovation and advantages of the offer

The use of FPGA-CNNs has many advantages over conventional serial software algorithms and even DSP--CNNs, including: deterministic and constant computational time (due to independence of computational time from image content); ease of adding new core columns in order to reduce computation time (computational time is inversely proportional to number of columns); reduced computational time in comparison with DSP--CNNs, due to non–sequential nature of execution flow.

Non-fusion Applications

The FPGA--CNN system has been developed for a hot spot recognition application in the JET tokamak. The potential domains of application include: video surveillance (e.g. remote and mobile monitoring, loss prevention, facility protection, traffic monitoring, public safety, employee safety); medical imaging (real-time MRI, surgery, diagnostics, image segmentation); vision-assisted intelligent robots; neural network modeling; real-time locomotion

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