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Milestone 1 Achieved - BrainChip Achieves Major Technology Advance with Application of SNAP Technology

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ASX RELEASE

Further to the previous announcements by Aziana regarding its pending acquisition of BrainChip, Aziana wishes to advise the market of significant new progress in the application of the Spiking Neuron Adaptive Processor ("SNAP") technology.

The BrainChip management team has advised Aziana that it has successfully completed their first performance milestone, a simulated race car demonstration proving the application of its SNAP technology. Further, that such demonstration and 'Proof of Concept' trial of SNAP demonstrates application in its objective to commercialise the technology.

Aziana, Managing Director Mr Neil Rinaldi said "We are delighted to receive this advice from the BrainChip team. It symbolises a major step forward in the application and commercialisation of this potentially ground-breaking technology. In particular, the completion advice of such a milestone illustrates the rapid progress the BrainChip team is making toward commercialisation and advancement of the technology.

This achievement has occurred ahead of schedule and is the first milestone in a series of post-acquisition milestones as the technology advanced toward commercialisation. Consequently, Aziana will be amending its notice of meeting and shareholder approval documentation to recognise the completion of this milestone. The other three remaining contingent milestones will be put to shareholders at the up-coming shareholders meeting to approve the transaction.

The Race Car Demonstration

In this demonstration the BrainChip team have applied its SNAP technology into a race car and demonstrates how the SNAP technology enables neurons to learn rapidly and much faster than has previously been achieved by alternative solutions. It also proves that a process can be learned and controlled using spiking neuron based learning, the same method that is used in the human brain.

BrainChip's SNAP technology can start with "blank" neurons that contain no knowledge whatsoever, and through rapid autonomous learning produces a functional set of synaptic values that express spike timing. The interface between the BrainChip neurons and a computer is also functioning and can configure the neural network for a specific function, in this case, learning to continually driving faster around the race-track without hitting the walls.

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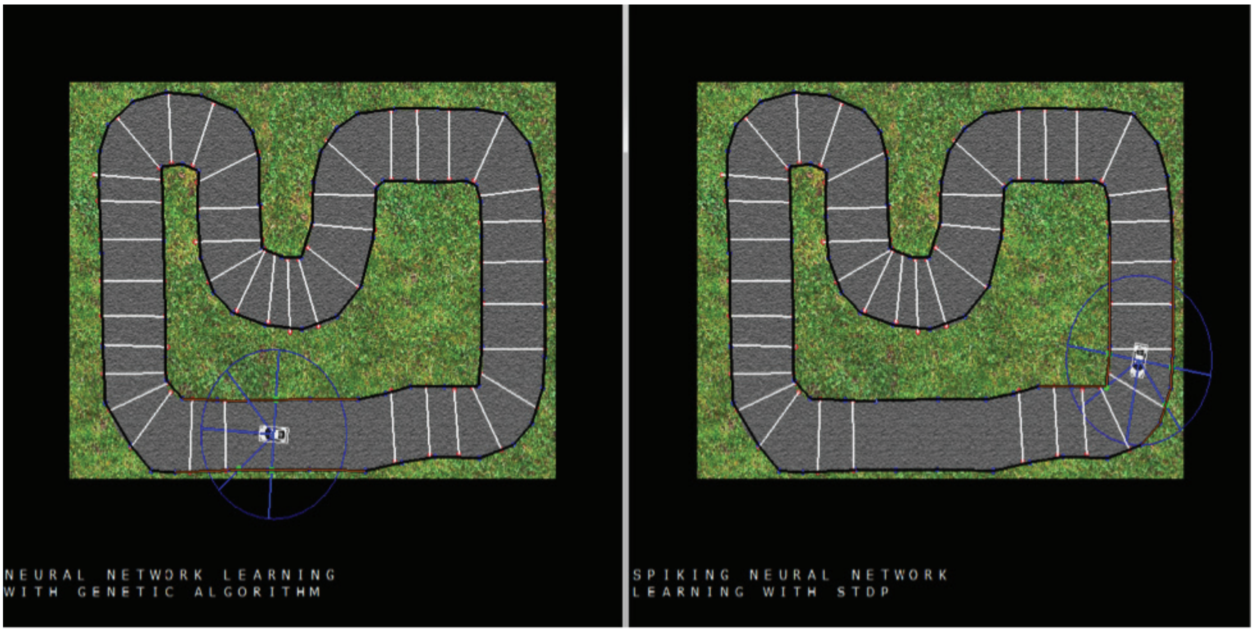

Figure 1: Snapshot of race car demonstration graphics

The two windows display a 2D simulated environment in which a car drives around a track and must learn to avoid walls. In both windows, a car is equipped with proximity sensors that measure distances between different parts of the car and the walls. Each car is controlled by a neural network that learns over time. Prior to starting the demonstration, both neural networks have no knowledge of the physical shape of the track. Under the demonstration, a sigmoid neural network model is compared with the spiking neural network of BrainChip. The learning method for each car is recorded, and their performance is compared.

In the left window, the car is controlled by a network of sigmoid neurons. Sigmoid neurons are a simple software model in which control values are added and the result is multiplied by a non-linear sigmoid function. The learning algorithm used in this simulation is a Genetic Algorithm that modifies the control values. A Genetic Algorithm is a well-known method for training artificial neural networks that creates "generations" of solutions, and then tests each solution for fitness. In this case, the 'fitness' function measures how long it takes for the car to crash. The values are kept if it takes longer for the car to crash than the previous generation, otherwise the values are wiped and a new generation is created. When a generation is successful it becomes a 'parent' to the next generation. This process is repeated until the car no longer crashes (about 24 generations in this demonstration). The fitness test is the reason why the car has to return to the beginning of the track to test the entire generation until the track can be successfully completed.

In the right window, the neural network controlling the car is composed of BrainChip spiking neurons. These simulated neurons transmit information by emitting spikes at specific times the same way real neurons in the human brain transmit (see Figure 2). The strength of the connections between neurons, called synapses, change over time as the network learns by a method known as STDP (Synaptic Time Dependent Plasticity). In this simulation, each time the car touches the wall, it experiences 'pain' from contact with the wall and learns to avoid it. After a single pass, the car has learned to drive around the track, avoiding the walls successfully and does not crash.

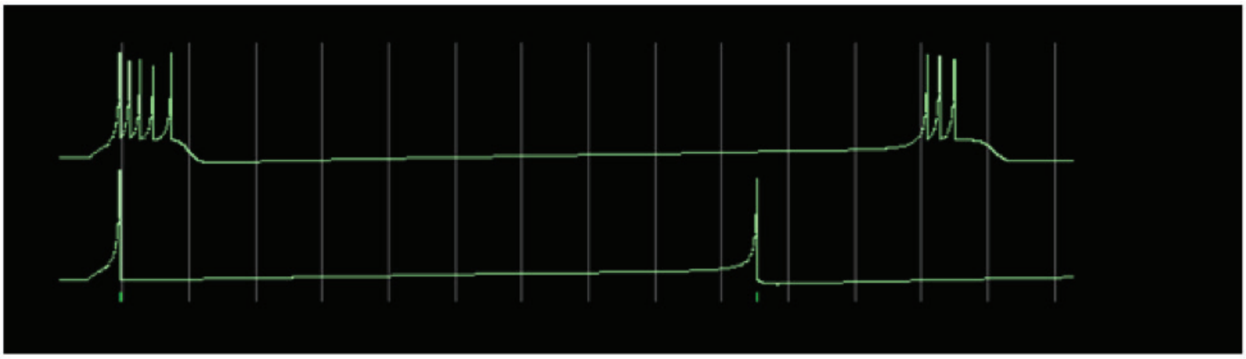

Figure 2. Example of spikes emitted by two neurons that have different properties. Thousands of this type of neurons are used in BrainChip's SNAP (Spiking Neural Adaptive Processor).

The BrainChip team believe this demonstration is a major advance in the application of its technology and that it will continue to evolve into SnapSim, a simulator for BrainChip neurons that potential clients can use to develop applications before accessing the BrainChip platform. Further, the BrainChip team believe that this Application Program Interface ("API") will continue to be expanded and documented as a tool for programmers to access the BrainChip SNAP accelerator, further enhancing its potential as a ground-breaking commercial application.

The Configuration of the Spiking Neural Network

The spiking neural network controlling the car is composed of seven sensory neurons and four motor neurons simulated on a computer's processor (CPU).

For this network, BrainChip applied a neuron model of complex synapses and an axon hillock called the Izhikevich model.

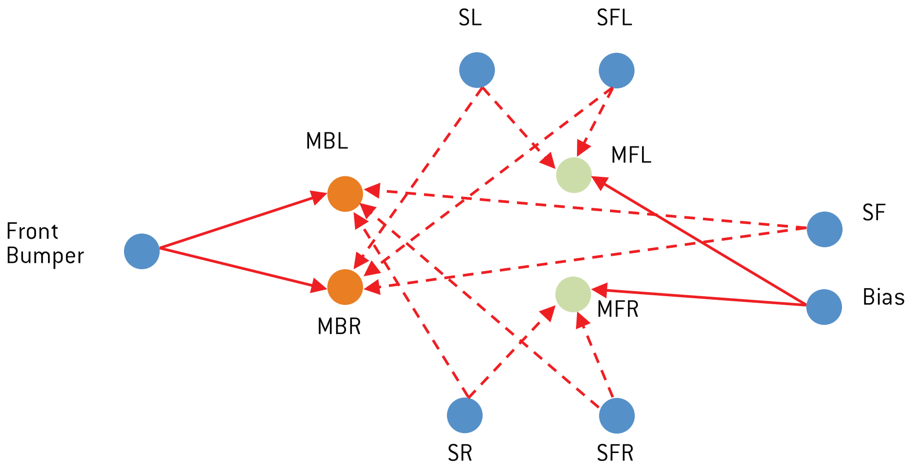

Figure 3. The neural network is composed of (the colors of the text relate to the drawing above): sensors, motor neurons (forward), motor neurons (backward), excitatory connections (dashed: plastic, solid: fixed). There are 11 neurons with 14 synapses. Learning occurs on plastic connections using STDP from sensory neurons to motor neurons (except from bias and bumper).

The five sensory neurons respond to proximity sensors located in different parts on the car: Left (SL), Front-Left (SFL), Front (SF), Front-Right (SFR), Right (SR). The values from the proximity sensors are mapped to currents that are injected into the corresponding sensory neurons. By doing so, the firing rate of sensory neurons is relational to the distance from the wall: the closer to the wall, the faster they spike. When the car hits a wall on the front, the bumper sensor will receive a high current causing a strong response, and be inactive otherwise. Coincidentally, a "Bias" neuron receives a constant current that causes the car to move forward by default. These seven sensory neurons are connected differently to the four motor neurons.

The four motor neurons control the wheels of the car. There are two motor neurons per wheel, with each neuron controlling a different direction: Backward-Left (MBL). Forward-Left (MFL), Backward-Right (MBR), Forward-Right (MFR). The number of spikes emitted by the motor neurons dictates the rotation speed of the wheels and thus the direction of travel.

Results of the Trial

As is depicted in the Left Window of Figure 1, the sigmoid-based neural network trained by a genetic algorithm, the learning process took 15 minutes and 24 generations to achieve a faultless lap.

As is depicted in the Right Window, the spiking-based neural network (of the Izhikevich model using the STDP learning method), the learning process was accomplished in one pass around the track, and took ~25 seconds.

This first Milestone has been executed in software to demonstrate "Proof of Concept" and it can be measured as being significantly faster than the Sigmoid neuron.

The BrainChip team have advised that having achieved this major milestone, they are now moving toward a hardware emulation using SNAP technology. Under this scenario, they believe the learning process would take significantly less time and would further demonstrate the key attributes of the SNAP, being its speed of learning whilst consuming substantially less power.

The BrainChip team will now move to emulate the process by implementing a hardware emulation of the Race Car Demonstration to perform the same function using the same API and illustrate the hardware scalability of the SNAP technology.

The Company remains on-track to complete the acquisition of BrainChip.

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