RF Neuromorphic System for IR-UWB Applications

Mots clés :
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Résumé du projet de recherche (Langue 1)

Context : While CMOS technology is currently reaching its limits in power consumption and circuit density, a challenger is emerging from the analogy between biology and silicon. Neuromorphic computing appeared in 90s as a complementary architecture to von Neumann systems (Schuman, 2017). At the time, analog circuits were designed to mimic biological neural systems as neuromorphic systems. Since then, digital neuromorphic systems have been often implemented in FPGAs considering its shorter design and manufacturing time, reconfigurability and reusability for different applications. From both solutions, analog circuitry has often been a good solution to implement the processing components of neurons and synapses, due to its ability to mimic biological systems. However, analog solutions have presented several reliability challenges (i.e., PVT variations) which are often overcome by digital solutions (Liu, 2010). Recently, the term has come to surround implementations that are based on biologically inspired or artificial neural networks using non-von Neumann architectures. By the increasing number of sensors and sensory systems (e.g., Internet-of-Things – IoT, or Software-Defined Radios - SDR), signal processing is becoming a baffling problem due to the large number and complex data. Neuromorphic engineering have focused significant effort on bio-inspired hardware. Neuromorphic sensing may drive a new generation of bio-inspired signal processing circuits (Liu, 2010). This solution is driven by the urge of hardware computing for real-time processing, compressive sensing and signal classification. Objectif : For many applications, IoT and SDR devices may require low-power consumption, wideband and neuromorphic signal processing as close to the antenna as possible. RF challenges in neuromorphic computing are not addressed in the state-of-the-art. The project RFneuron which aims to study wideband neuromorphic system, including impulse radio architecture, is composed of an energy detector (ED) capable to convert RF power into DC current, an artificial neuron (eNeuron) according to Izhikevich’s model, and a time-to-digital converter (TDC). New bio-inspired RF circuits would meet the needs of connected objects, in particular in terms of context and energy aware issues, including for example blind estimation of channels and space-time information, but also in terms cognitive behavior.