Universal controller and virtual sensor

CSIC, in collaboration with the University of Seville, has developed a method to provide the generation of digital circuits that implement multivariable Piece-Wise Affine (PWA) functions without approximations. These circuits offer a high performance in terms of area, speed, and power. The method presents two additional features: programmability and re-configurability. Both characteristics allow the implementation of several functions in the same integrated circuit, generating devices that could integrate the requirements of any controller or virtual sensor easily.

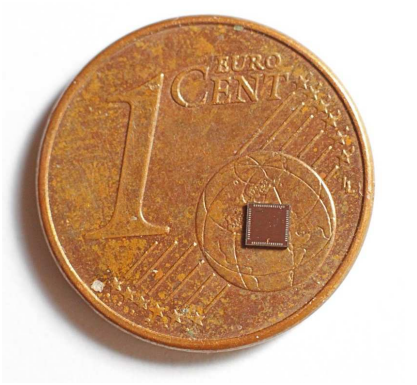
An offer for patent licensing

Description of the offer

Piece-Wise Affine (PWA) functions are universal approximating functions that can be used to represent control laws (universal controllers) and/or estimation laws (virtual sensors). Once the mathematical representation of the PWA function has been developed, the method allows the generation of a circuit that implements this function exactly, that is, without approximations. In the literature, there are other integrated circuits that implement approximated functions being not able to generate any kind of PWA function.

This aspect is fundamental since these approximations are not valid in several control processes where they are unable to regulate the plant or the process to be controlled. This is why the development of a method is necessary to overcome this limitation. Therefore, this methodology provides a method that allows the generation of multivariable PWA functions in an exact way, that is, without approximations.

Additionally, the method allows the generation of a programmable and reconfigurable device. In terms of the programmability, the method provides a circuit that can work with different functions, obtaining different controllers and virtual sensors. In terms of reconfigurability, different parameters can be configured adding versatility to the circuit without reducing the high performance that offers the dedicated hardware. Both characteristics are crucial in the methodology to offer universal controllers and virtual sensors.



Comparative size picture of the prototype built with the patented method. This circuit can be used as controller in multidisciplinar sectors such as automotive, consumer electronics, aerospace, chemical, etc.

Main applications and advantages

- The circuit implementation is independent of the fabrication technology. This method has been used to integrate prototypes in a nanometric CMOS technology (TSMC 90nm).
- The prototype can implement up to four inputs and one output, with a maximum depth of the search tree equal to thirteen and a maximum number of polytypes equal to 4096 that correspond to a system with relative complexity.
- Some examples that show the versatility of the method, prototypes have been used in automotive applications, such as an Adaptive Cruise Control (ACC) system, and consumer electronics, Buck-Boost DC-DC Converters, satisfactorily.
- As an additional advantage to the high performance that offers the ASIC solutions in terms of area, speed and power, it is important to remark the low cost of ASICs in comparison to the current FPGA solutions that implement PWA functions exactly, especially when the production volume is high.

Patent status

Priority patent application filed, suitable for international extension

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