Contribution ID: **234** Type: **Oral presentation**

Pattern matching Unit for Medical Applications

Friday 16 October 2020 07:35 (20 minutes)

We explore the application of concepts developed in High Energy Physics (HEP) for advanced medical data analysis.

Our study case is a problem with high social impact: clinically-feasible Magnetic Resonance Fingerprinting (MRF). MRF is a new, quantitative, imaging technique that replaces multiple qualitative MRI exams with a single, reproducible measurement for increased sensitivity and efficiency. A fast acquisition is followed by a pattern matching (PM) task, where signal responses are matched to entries from a dictionary of simulated, physically-feasible responses, yielding multiple tissue parameters simultaneously. Each pixel signal response in the volume is compared through scalar products with all dictionary entries to choose the best measurement reproduction. MRF is limited by the PM processing time, which scales exponentially with the dictionary dimensionality, i.e. with the number of tissue parameters to be reconstructed. We developed for HEP a powerful, compact, embedded system, optimized for extremely fast PM. This system executes real-time tracking for online event selection in the HEP experiments, exploiting maximum parallelism and pipelining.
Track reconstruction is executed in two steps. The Associative Memory (AM) ASIC first implements a PM algorithm by recognizing track candidates at low resolution. The second step, which is implemented into FPGAs (Field Programmable Gate Arrays), refines the AM output finding the track parameters at full resolution.

We propose to use this system to perform MRF, to achieve clinically reasonable reconstruction time. This paper proposes an adaptation of the HEP system for medical imaging and shows some preliminary results.

Minioral

Yes

IEEE Member

No

Are you a student?

No

Authors: LEOMBRUNI, Orlando (Universita & INFN Pisa (IT)); ANNOVI, Alberto (INFN Sezione di Pisa, Università e Scuola Normale Superiore, Pisa); GIANNETTI, Paola (INFN Sezione di Pisa, Universita' e Scuola Normale Superiore, P); Dr BIESUZ, Nicolo Vladi (Universita & INFN Pisa (IT)); Dr BUONINCONTRI, Guido (IRCCS Stella Maris and Imago7 Foundation); CALVETTI, Milene (INFN Pisa, University of Pisa); Dr CENCINI, Matteo (IRCCS Stella Maris and Imago7 Foundation); PIENDIBENE, Marco (Universita & INFN Pisa (IT)); Mr PERETTI, Luca (Università di Pisa and Imago7 Foundation); RODA, Chiara (Universita & INFN Pisa (IT)); Dr TOSETTI, Michela (IRCCS Stella Maris and Imago7 Foundation)

Presenter: LEOMBRUNI, Orlando (Universita & INFN Pisa (IT))

Session Classification: Oral presentations DAQ03

Track Classification: Emerging Technologies, New Standards and Feedback on Experience