



Coarse-Grain Load Distribution in Heterogeneous Computing

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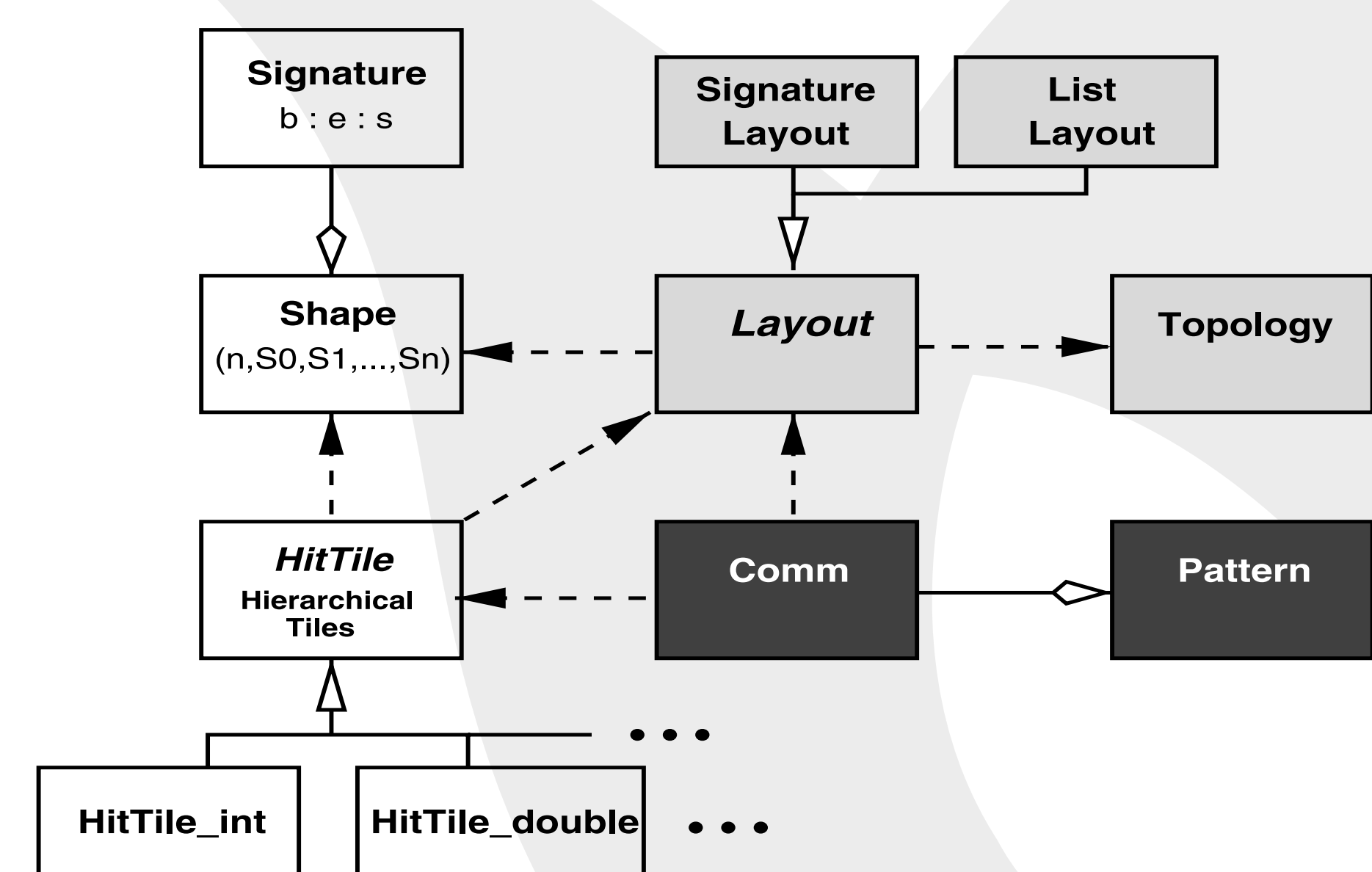
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INTRODUCTION

- HPC heterogeneous clusters are composed by different type of machines.
 - Various types of component manufacturers.
 - Varying computational capacities.
 - Different hardware accelerators.
- The most common type of data distributions is the equal division of the data across all the nodes.
- A more sophisticated policy of data distribution is needed to explore the computational capacity of the entire system.
- In this poster we summarize the recent research advances of our group designing and building a plug-in to enable a weighted partitioning of data in Hitmap library [1].
- **Poster contribution**
 - (1) A brief description of Hitmap library.
 - (2) A description of the Weighted Layout.
 - (3) Some Weighted Layout results.
 - (4) On-going work about Coarse-Grain Load Distribution.

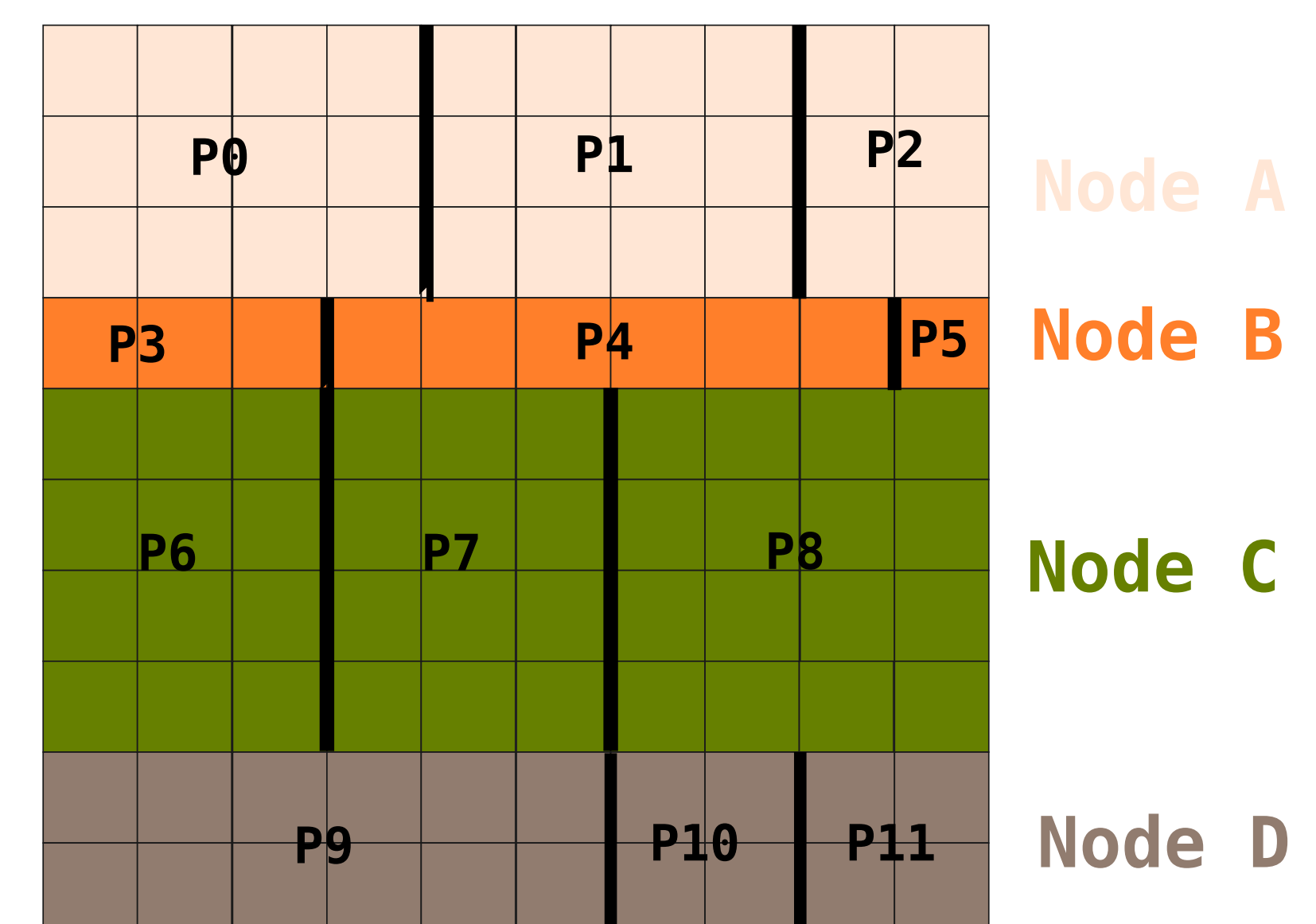
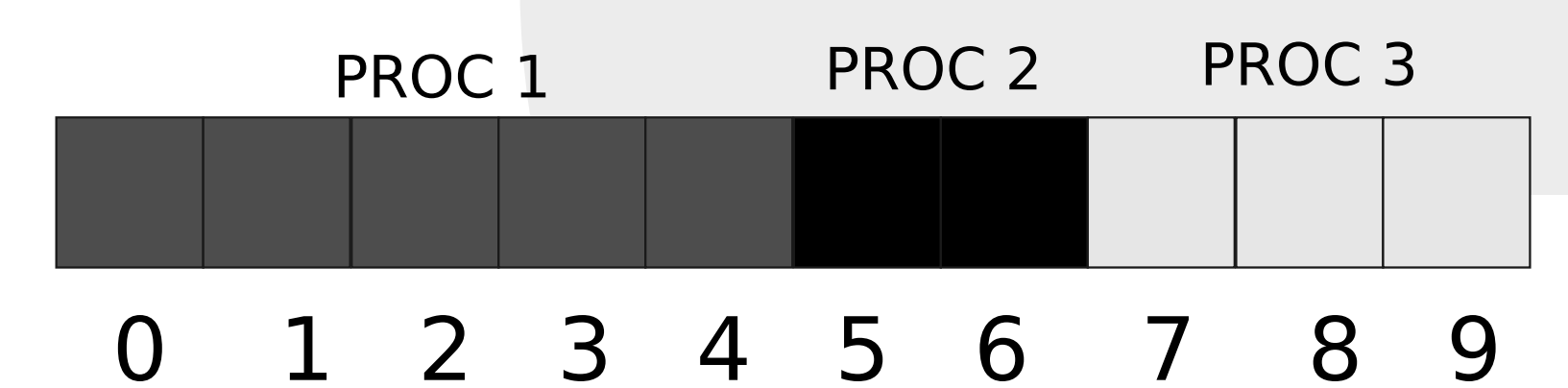
HITMAP LIBRARY

- It is a library designed to decouple the communication pattern from data partitioning.
- Its architecture has three differentiable parts: Tiling (Tiles, Shapes and Signatures), Mapping (Layouts and Topologies) and Communication (Comm. and Comm. Patterns)
- Automatically computes data-partition and distributions of tiles in **run-time** as a function of the **Layout** and **Topology**.
- To integrate another type of data distribution in the library, a new Hitmap Layout has to be developed.



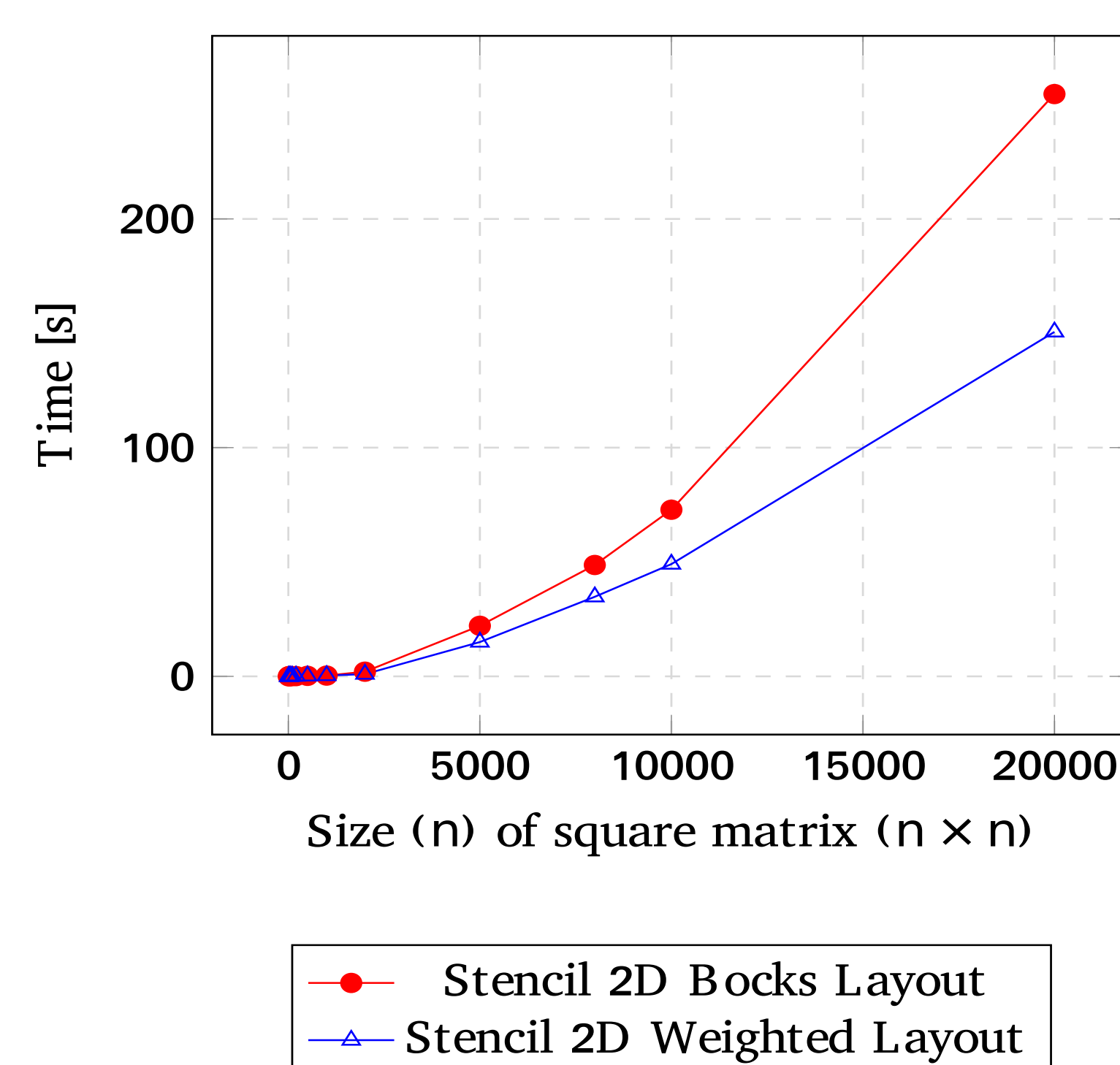
WEIGHTEDLAYOUT

- **Distributes the data across the processes of the cluster using weights**
 - Using the vector of weights [0.5,0.2,0.3] in a three-process execution of a ten-element array, a distribution like the one showed in the first figure of the right is obtained in that array.
- **Compatible with n dimensional structures**
 - Weighted distributions in Tiles of one dimension.
 - Weighted distribution in Tiles of multiple dimensions
 - * By one dimension (ie: distribution of rows or columns in a 2D structure)
 - * By various dimensions (ie: by rectangles in a prism)
 - * By all dimensions (ie: the partition showed in the second fig.)
- **Everything is done at run-time**



WEIGHTEDLAYOUT RESULTS

- **Stencil 2D Jacobi example**
 - Weighted Layout vs Blocks Distribution Layout.
 - The run-time is reduced using the Weighted Layout.
 - The bigger the size of input matrix, the greater the efficiency using the Weighted Layout.



CONCLUSIONS

- ⇒ **Load Distribution in Het. Comp.:** (1) System to perform an efficient load distribution in heterogeneous systems; (2) Currently: Hitmap plug-in; (3) n dimensional hierarchical partitions; (4) Run-time distribution
- ⇒ **On-going work:** (1) Automatic partition and load balancing techniques. (2) Integration in Controller [2].

REFERENCES

- [1] ARTURO GONZALEZ-ESCRIBANO, YURI TORRES, JAVIER FRESNO, AND DIEGO R. LLANOS. An Extensible System for Multilevel Automatic Data Partition and Mapping. IEEE Transactions on Parallel and Distributed Systems 9, 1145–1154, 2014, ISSN 1045-9219.
- [2] ANA MORETON FERNANDEZ, HECTOR ORTEGA ARRANZ, AND ARTURO GONZALEZ-ESCRIBANO. Controllers: An abstraction to ease the use of hardware accelerators. The International Journal of High Performance Computing Applications 16, 1-16, 2017, DOI 10.1177/1094342017702962.