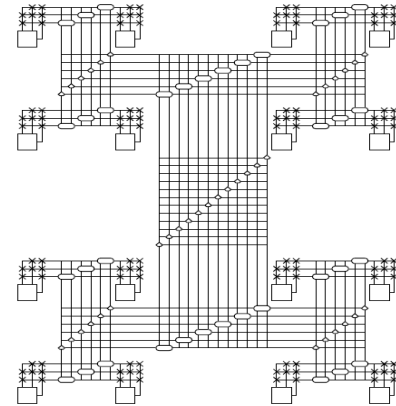# Balancing Interconnect and Computation in a Reconfigurable Computing Array (or, why you don't really want 100% LUT utilization)

André DeHon

Year of publication: *1999*
Area: *Architecture*

This is a model paper for the FPGA conference – an excellent mix of theory, empirical analysis and insightful commentary. The results break commonly-held assumptions about FPGA architecture optimization and in particular demonstrate that the relative breakdown of logic area vs. routing-mux area leads to an optimal point at which logic utilization is not 100%.

This was the first paper to explain the wiring needs of different pieces of a design and the relationship between worst-case wiring requirements and its effect on the overall cost of the device. The paper influenced many future research efforts on FPGA architecture and continues to be cited more than a decade after publication. The definition of a routing approach that would later evolve to the HSRA [see Tsu, et. al. 1999] also revived interest in hierarchical FPGA architectures and their analysis in both academia and industry.

One other contribution is a clear description of the correspondence between the style of architecture and the style of the CAD algorithms – in this case hierarchical and recursive decomposition. DeHon further contrasts the relationship between interconnect growth rate and device size and the empirical results on the efficiency of the architecture at packing designs.

Perhaps the most notable aspect of this work, however, is the overall methodology. Using an architectural model based on tree-of-meshes allowed for a more scalable theoretical model of interconnect growth tied into traditional Rent-based wireability and additionally challenged the traditional concept of a tiled array of logic clusters. At the same time, a concrete area model is used to provide practical credibility to the data that comes from the empirical analysis. Where results differ from the conventional wisdom, DeHon provides clear intuition for the underlying behavior. The overall impact is strengthened by the comprehensiveness of this approach.

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