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OF EMERGING TECHNOLOGIES

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# Topolinano & MagCAD: a Design and Simulation Framework for the Exploration of Emerging Technologies

Umberto Garlando, Fabrizio Riente, Maurizio Zamboni and Mariagrazia Graziano  
Department of Electronics and Telecommunications, Politecnico di Torino, Turin 10129, Italy.

The scaling of CMOS technology is reaching its limits [1]. The technology trend known as Moore Law will be no longer valid in few years. Researchers are studying technological alternatives to overcome this situation. Field coupled devices, and in particular Nano-Magnet Logic (NML), seem to be the most valuable alternative to CMOS technology [2]. The new paradigms brought in by this new technology lead to a lack of compatible Computer Aided Design (CAD) tools. Indeed, no commercial tools enable the simulation this kind of circuits. The proposed software, ToPoliNano [3], is a possible answer to these needs. Indeed, it embeds a place&route engine, simulation tools and a custom design editor called MagCAD [4]. These two tools are part of the ToPoliNano framework (Fig. 1). Different technological implementations of NML are already supported within the suite; however, the structure of the code has been conceived to be easily extended thanks to its modularity. The main flow of ToPoliNano starts with the analysis of a VHDL description, indeed, users are able to write their own circuit description directly into the software or can load existing files from custom folder. Then, the place&route engine optimizes the layout of the target circuit and show its graphical representation. Furthermore, the circuit can be simulated at different levels: the user can select between a logical or a physical simulation. MagCAD is a tool enabling the graphical design of circuit by placing basic elements of the selected technology. The software can extract a VHDL description of the layout: this description is based on a compact model of the technological elements, derived from physical experiments, that can be simulated with a standard VHDL simulator. Both ToPoliNano and MagCad have been developed for Windows, CentOS and MacOS, and can be downloaded from the ToPoliNano website (<https://topolinano.polito.it>).

The aim is to demonstrate the capabilities of our framework. To fully understand the potentiality of it, three demonstrations have been prepared:

I) A complete design flow with MagCAD shows how it is possible to draw circuits based on the iNML [5] and pNML [6] technologies. Moreover, circuits are exported into a VHDL project which can be simulated with ModelSim or to a custom format which can be imported into ToPoliNano.

II) With ToPoliNano a complete working flow is presented: starting from the VHDL description of the circuit, the place & route and the simulation, which verifies the logic correctness of the studied circuit, are shown.

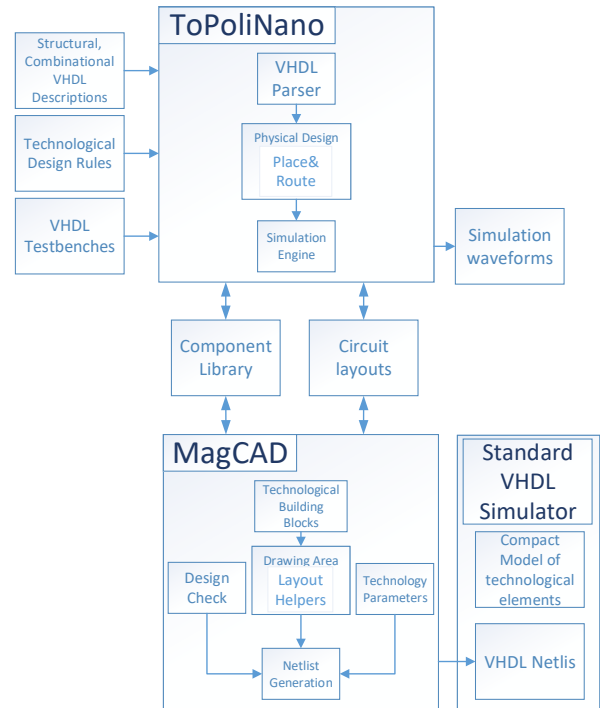


Fig. 1. ToPoliNano design framework overview

III) The interaction between ToPoliNano and MagCAD is shown. Custom circuits designed in MagCAD can be reused as component by the ToPoliNano place & route engine.

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