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Utilizing Petri-Nets to Represent Electromagnetic Waveguide Junction Switching Processes

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Switching and routing processes play a central role in computing systems. The emergence of optical computing has prompted interest in how current computing processes can be recreated. However, as the field aims to emulate the pervasive utility of current computing technologies, then it should have analogous components to perform high-speed switching. Recent work in the field of photonics and plasmonics for optical computing has demonstrated the perfect beam-splitting properties of waveguide junctions and their applications in the creation of photonic logic circuits[1, 2, 3]. In this work, we explore an intermediary interpretive layer in the design of waveguide junctions for computing in the form of a generalized, graphical, and discrete method of modelling systems called Petri Nets (PNs). PNs are a widely deployed graphical modelling technique, they are used in industries such as circuit modelling [4] and chemical engineering [5].

As it will be discussed during the conference, PNs can be used to represent the scattering matrices of three-port and four-port waveguides [6] (series or parallel configuration). In particular, we show how interaction of transverse electromagnetic (TEM) square pulses in interconnected waveguide junctions can be analytically modelled using PNs at a fraction of the computational cost required for full-wave simulations in software. Recreation of classical computing processes in optical computing using waveguide junctions is primarily motivated to form logic gates using combinations of waveguide junctions [3]. Our work may open new directions in the modeling of computing processes via waveguide junctions using simple and efficient approaches such as PNs. Full details and different configurations of waveguide junctions will be discussed during the conference.

References

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