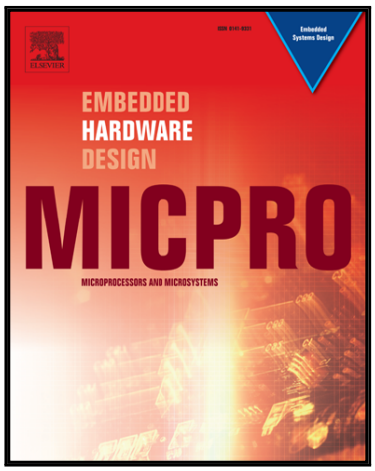

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PII: S0141-9331(17)30165-5
DOI: 10.1016/j.micpro.2018.06.004
Reference: MICPRO 2704

To appear in: *Microprocessors and Microsystems*

Received date: 15 March 2017
Revised date: 27 April 2018
Accepted date: 11 June 2018

Please cite this article as: A. Benmessaoud Gabis, P. Bomel, M. Sevaux, Application-aware Multi-Objective Routing based on Genetic Algorithm for 2D Network-on-Chip, *Microprocessors and Microsystems* (2018), doi: 10.1016/j.micpro.2018.06.004

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Microprocessors and Microsystems 00 (2018) 1–24

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Application-aware Multi-Objective Routing based on Genetic Algorithm for 2D Network-on-Chip

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Abstract

This paper presents a technique using a genetic algorithm to compute an efficient routing for an application-specific NoC (Network-on-Chip). The main goal of this paper is to introduce multi-objective optimization techniques to address the NoC routing. Thus, Pareto optimization has been used to determine non-dominated solutions according to two fixed objectives: i) avoiding the reuse of same links as far as possible to reduce congestion; ii) reducing the number of loops to limit the risk of deadlocks. The proposed method called MORGA (Multi-Objective Routing based on Genetic Algorithm) uses two steps: i) an off-line process consisting at selecting a non-dominated solution among a pre-calculated population of solutions; ii) an on-line process allowing the data transmission based on the built solution by the use of routing tables. MORGA is also applicable in the presence of permanent faulty links by calculating fault-free solutions. A reconfiguration of routing tables is performed when a new application is loaded on the system. Results show how a selection of the most appropriate solution can provide considerable improvement in performance.

Keywords: Network on Chip; Application-based Routing Protocol; Multi-Objective; Genetic Algorithm; Pareto Optimization.

1. Introduction

According to [1], four main NoC routing issues are source of problems in NoC routing protocols: deadlock, livelock, congestion and faults. Consequently, a considerable reduction of reliability is noted. To deal with this situation, many routing techniques are developed using either deterministic approaches or adaptive ones. However, each of them presents some drawbacks decreasing the NoC performance.

In fact, deterministic techniques [2, 3, 4, 5] are good to help in avoiding deadlocks while offering interesting latencies, but they cause congestion regions especially in the center of the NoC. This may induce an overheating, faulty links and may even block the NoC partially or totally. An alternative solution is the use Virtual Channels (VCs) [6, 7]. They provide more links and contribute to avoid congestion and to tolerate faults. However, they require more buffers.

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