Heuristic algorithms for the min-max edge 2-coloring problem

Radu Stefan Mincu[1] and Alexandru Popa[1,2]

[1] Department of Computer Science, University of Bucharest
[2] National Institute for Research and Development in Informatics
E-mail: mincu.radu@fmi.unibuc.ro, alexandru.popa@fmi.unibuc.ro

Abstract. In multi-channel Wireless Mesh Networks (WMN), each node is able to use multiple non-overlapping frequency channels. Raniwala et al. (Mobile Computing and Communications Review 2004, INFOCOM 2005) propose and study several such architectures in which a computer can have multiple network interface cards. These architectures are modeled as a graph problem named *maximum edge q-coloring* and studied in several papers by Feng et. al (TAMC 2007), Adamazek and Popa (ISAAC 2010, Journal of Discrete Algorithms 2016). Later on Larjomaa and Popa (IWOCA 2014, Journal of Graph Algorithms and Applications 2015) define and study an alternative variant, named the *min-max edge q-coloring*.

The above mentioned graph problems, namely the maximum edge q-coloring and the min-max edge q-coloring are studied mainly from the theoretical perspective. In this paper, we study the min-max edge 2-coloring problem from a practical perspective. More precisely, we introduce, implement and test four heuristic approximation algorithms for the min-max edge 2-coloring problem. These algorithms are based on a *Breadth First Search* (BFS)-based heuristic and on *local search* methods like basic *hill climbing*, *simulated annealing* and *tabu search* techniques, respectively. Although several algorithms for particular graph classes were proposed by Larjomaa and Popa (e.g., trees, planar graphs, cliques, bi-cliques, hypergraphs), we design the first algorithms for general graphs.

We study and compare the running data for all algorithms on Unit Disk Graphs, as well as some graphs from the DIMACS vertex coloring benchmark dataset.

Keywords: graph algorithms, edge coloring, local search, heuristics, metaheuristics, NP-hard problems, wireless mesh networks