

Special Issue on Reconfiguration Problems

Faisal Abu-Khzam ^{1,*}, Henning Fernau ²  and Ryuhei Uehara ^{3,*} 

¹ Department of Computer Science and Mathematics, Lebanese American University, Beirut 11022801, Lebanon

² Informatikwissenschaften, CIRT, FB IV, Universität Trier, Universitätsring 15, 54296 Trier, Germany; fernau@uni-trier.de

³ School of Information Science, Japan Advanced Institute of Science and Technology, Asahidai 1-1, Nomi, Ishikawa 923-1292, Japan

* Correspondence: faisal.abukhzam@lau.edu.lb (F.A.-K.); uehara@jaist.ac.jp (R.U.); Tel.: +961-1-786456 (F.A.-K.)

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Abstract: The study of reconfiguration problems has grown into a field of its own. The basic idea is to consider the scenario of moving from one given (feasible) solution to another, maintaining feasibility for all intermediate solutions. The solution space is often represented by a “reconfiguration graph”, where vertices represent solutions to the problem in hand and an edge between two vertices means that one can be obtained from the other in one step. A typical application background would be for a reorganization or repair work that has to be done without interruption to the service that is provided.

Keywords: reconfiguration problem; computational complexity

1. Introduction

Back in February 2017, a workshop on *Combinatorial Reconfiguration* (see <http://www.birs.ca/events/2017/5-day-workshops/17w5066>) was organized at the Banff International Research Station for Mathematical Innovation and Discovery, or BIRS for short. This triggered quite a number of new research contacts, and so the idea was born to set up a Special Issue on Reconfiguration. An according Call was placed in particular towards the participants of the mentioned workshop.

The mentioned workshop was initiated by Naomi Nishimura, who also contributed a nice introduction and survey into this area for this Special Issue. Hence, we recommend to read [1] <https://www.mdpi.com/1999-4893/11/4/52> as a start to the topic of this Special Issue.

2. Papers in this Special Issue

In response to the call for papers, we selected four submissions for this special issue. All submissions have been reviewed by at least two experts in reconfiguration problems. We survey below the published papers ordered by their publication dates.

In their first paper on the complexity of the Vertex Cover Reconfiguration problem (VCR) [2], Mouawad et al. show that VCR is $W[1]$ -hard on bipartite graphs but fixed-parameter tractable on nowhere dense graphs. They also show the problem is solvable in polynomial time on trees as well as (under some assumptions) cactus graphs.

In the second paper by Haas and MacGillivray [3], the authors consider the reconfiguration graph of the Canonical k -Coloring problem. They show that such reconfiguration graph is connected for a particular given sequence and for large enough value of k . Moreover, the authors study the Hamiltonicity of this reconfiguration graph when the problem is restricted to complete multipartite

graphs. In particular, while such reconfiguration graph is not Hamiltonian (in general), the authors show that it does contain a Hamiltonian path for $k \geq 3$ with respect to a given ordering.

The third paper by Naomi Nishimura [1], mentioned above, provides an excellent survey of the topic via a thorough exposition of known structural results, such as those pertaining to the connectivity of a reconfiguration graph, as well as algorithmic methods.

In the fourth (and last) accepted paper on the complexity of Hamiltonian Cycle reconfiguration [4], Asahi Takaoka improves the state of the art by proving that the problem is PSPACE-complete for a number of special graph classes, such as chordal bipartite graphs, strongly chordal split graphs, and bipartite graphs with maximum degree 6. On the positive side, Takaoka shows constructively the existence of linear time algorithms that solve the problem on bipartite permutation graphs and on unit interval graphs.

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