Final publishable summary report

The project PaECiDM (628974) was held at the Institute of Mathematics of the Czech Academy of Sciences from 1 September 2014 to 31 August 2016. The Researcher for the project was Jan Hladký and the Scientist in Charge was Pavel Pudlák.

The project PaECiDM concerns research on the frontier between discrete mathematics and theoretical computer science. Discrete mathematics is an established mathematical discipline and is playing an increasing role in various fields of mathematics. Many real-life problems can be formulated using the language of discrete mathematics. Deep mathematics is hidden behind practical problems such as devising optimal schedules, or efficient routing of data packets through the internet. These problems also suggest that in addition to problems typical to pure mathematics (such as existence of a solution) one often seeks their efficient algorithmic counterparts (algorithm design). The research objectives for the reporting period were to study various concepts relating to expanders (in particular of monotone expanders, dimension expanders in the area of explicit Ramsey graphs, partition expanders), to understand the nature of pseudorandomness needed for their construction, and to provide alternative, more combinatorial approaches to these constructions. In the process of doing so, Hladký also contributed to related areas of random graphs, use of random and quasirandom methods in extremal graph theory, making substantial progress on several long-standing problems.

The project has been successfully accomplished and achieved all its objectives. The new scientific results obtained by the Researcher are within the following mathematical topics.

- Cliques in inhomogeneous random graphs: The work freely available at [arXiv:1510.02335 Doležal, Hladký, Máthé] contributed to (obj4) and (obj6) of Annex I.

- Upper bound theorem for odd-dimensional flag triangulations of manifolds: The result freely available at [arXiv: 1503.05961 Adamaszek, Hladký] is stemming from Researches's work on (obj2) of Annex I (more specifically, on his work on dimension expanders and their connections to geometry and extremal graph theory).

- Tilings and matchings in graphons: Articles freely available at [arXiv:1606.03113 Hladký, Hu, Piguet], [arXiv:1606.06958 Doležal, Hladký], [arXiv:1607.08415 Hladký, Hu, Piguet] contributed to (obj4) and (obj 6) of Annex I.

- Graceful tree conjecture: The work freely available at [arXiv:1608.01577 Adamaszek, Allen, Grosu, Hladký] contributed to (obj1) from Annex I.

- Chromatic roots and limits of dense graphs: The work freely available at [arXiv:1511.09429 Csikvari, Frenkel, Hladký, Hubai] contributed to (obj4) of Annex I.

Target groups:

The results are targeted on specialists in discrete mathematics. Hladký has given 11 talks at discrete math seminars at universities/research institutions in 5 countries, 3 colloquia talks in 3 countries and 6 (invited or non-invited) talks at conferences in 5 countries about his research. The support of the Marie

Curie actions was acknowledged at each occasion. The slides of the talks are available at http://users.math.cas.cz/~hladky/oldtalks.html.

During the fellowship Hladký was awarded the Otto Wichterle Award of the Czech Academy of Sciences in the spring of 2016, see http://www.avcr.cz/en/academic-public/support-of-research/otto-wichterle-award/

Benefits of the project:

Thanks to the project the Researcher had a possibility to be exposed to different research environments and this helped to broad his research competences. The project also contributed to qualitative improvement in the Researcher career perspectives, which is proved by the recent fact of awarding to the Researcher the Humboldt fellowship at the University of Dresden, Germany.

Additionally, participation in training program helped the Researcher to gain the following complementary skills: management competencies (self-managing of own individual project), organizational skills (the fellow prepared successful applications for external funding and organized the Summer School on Discrete Mathematics in Prague), improving language competencies (he attended the French language course).

On a higher level the project contributed to strengthening the existing collaboration links and creating new ones between Institute of Mathematics of the Czech Academy of Sciences and the Faculty of Mathematics and Physics of the Charles University in Prague (during the fellowship the Researcher cooperated with Z. Dvorak, M. Koucky, and J. Sgall from the university, also the school was jointly organized by both institutions), which in result is a great benefit for the Czech scientific community.