STSM by Matko Ljulj (Faculty of Science, University of Zagreb, Croatia)

Homogenization of periodic networks of elastic rods

at TU Darmstadt, Germany (27 February to 4 March 2020)

Background information. The purpose of this short-term scientific mission was to intensify collaboration between members of our group, including University of Zagreb's prof. Josip Tambača and TU Darmstadt's PD Dr. Kersten Schmidt and Dr. Adrien Semin. We work on topics related to homogenization of PDE's on networks, starting with Poisson equation with the goal of generalizing the ideas to elasticity problems (homogenization of equations describing one-dimensional elastic rods). Due to the shortness of the visit, main goal was to make a significant breakthrough in at least one of the regimes in elasticity (flexural or membrane regime) during the stay.

The problem observed during the visit is the stationary problem for the net of elastic rods (bodies much thinner in two dimensions than in the third) situated in a plane with topology that includes a certain periodically repeating pattern, in the view of homogenization.
According to our knowledge, until now this problem is usually solved without homogenization or by applying three-dimensional model for rods, which are naturally modelled by a one-dimensional model. Both such existing approaches for the main disadvantage have big computational cost due to a great number of rods appearing in the net or due to density of the mesh applied for the thin objects. In the new view (homogenization of the one-dimensional elastic equations) those disadvantages should be avoided.

Results of the Short Term Scientific Mission. This STSM indeed helped us to obtain some useful results by intense in-person meetings, even more than we initially thought having in mind circumstances that appeared shortly after our return to Zagreb and during the majority of the last year. We hope that soon we will continue our collaboration on the mention topic, and hopefully eventually arrive to more general model including networks of rods in case of curved geometry with the application in the case of biomedic stents.