DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

The development of modern materials demands continuous optimization, both in terms of technical characteristics of the materials, as well as manufacturing economics or environmental issues. Considering all these factors with conventional experimental techniques often does not lead to satisfactory results or is not practically achievable at all.

In the second half of 20th century material science has gained a new tool in the form of computer simulation. Initially, its use was limited by available computing power of early computers. Rapid development of computational sciences in 21st century allowed their use on a practical scale, since they have been recognized as equally useful tool for scientific knowledge, beside theoretical concepts and experimental testing in the lab. Extensive use of *in silico* modelling techniques significantly shortened the optimization loop in material and construction design, led to more effective planning of laboratory tests, finally expanding researcher's perspective, with the possibility to precisely track new phenomena, impossible to capture in the lab.

The aim of the project is to develop efficient numerical tools for high-resolution simulation of material's internal structure under mechanical and thermal loads. Data obtained with modern imaging techniques (SEM, microCT) will be used to generate statistical models, then sets of virtual micro- and nanostructures. This will enable sensitivity analysis of resulting materials with respect to manufacturing conditions, as a first step towards optimization.

This interdisciplinary project combines knowledge in multiple areas, such as: computational mechanics, numerical methods, material science, image processing and software engineering. Presented solutions will be scalable from single-core computers to clusters. This comprehensive approach will provide many necessary tools to improve existing and search for new materials, with more demanding applications.