Efficient Execution of Grid-based Multiscale Applications for Metallurgical Industry

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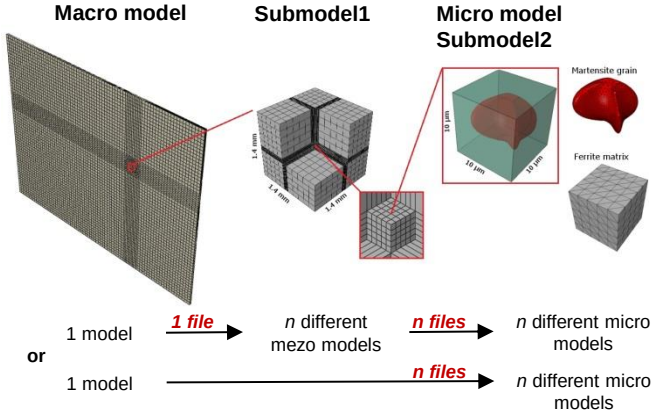
Abstract

Numerical simulations, implemented and applied in computational science dedicated to metallurgy, became very sophisticated nowadays and computationally demanding. In many cases they require huge computing resources as well as creation of new algorithms for innovative hardware architectures. The major part of currently applied approaches are multiscale simulations, which offers numerical solution in macro and micro scales simulataneously. Some of these approaches are tightly coupled with full communication between simulated scales. But some of them are loosely coupled without any feedback from micro to macro scale. These solutions are typical representatives of submodelling methodology and are the main subject of this work. On the other hand, complex and heterogeneous hardware architectures require optimal deployment of created computing procedures, which in the case of multiscale approaches is usually very sophisticated task. Therefore, the main objective of this work is design and implementation of new grid-based multiscale applications joined with Grid Space software, supporting deployment in real grid infrastructure. Details of proposed approaches and obtained results are presented in this work as well.

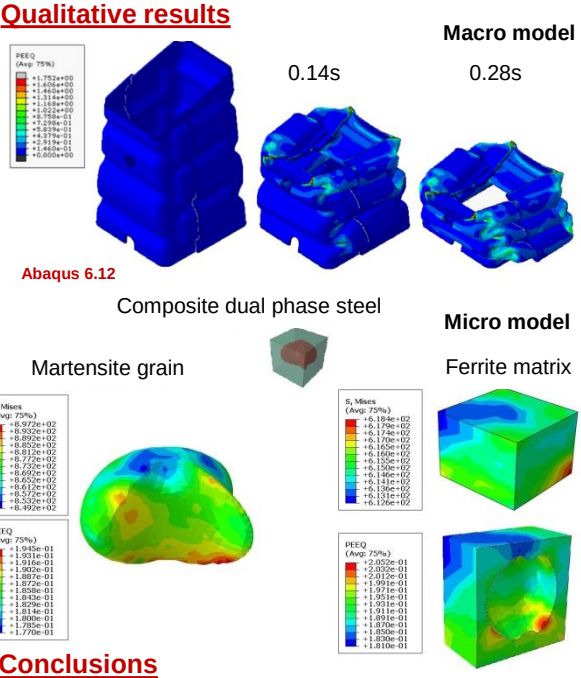
Introduction

Advanced High Strength Steels (AHSS) are now commonly used for manufacturing of car body parts. Particular properties of these steels, high strength and good workability, are obtained by combination of a soft ferritic matrix with tough phases of bainite, martensite and retained austenite. Therefore, reliable numerical simulations of production processes based on such steels require precise and very demanding multiscale procedures. For the purposes of this work the production process of crash box manufactured for automotive industry is considered.

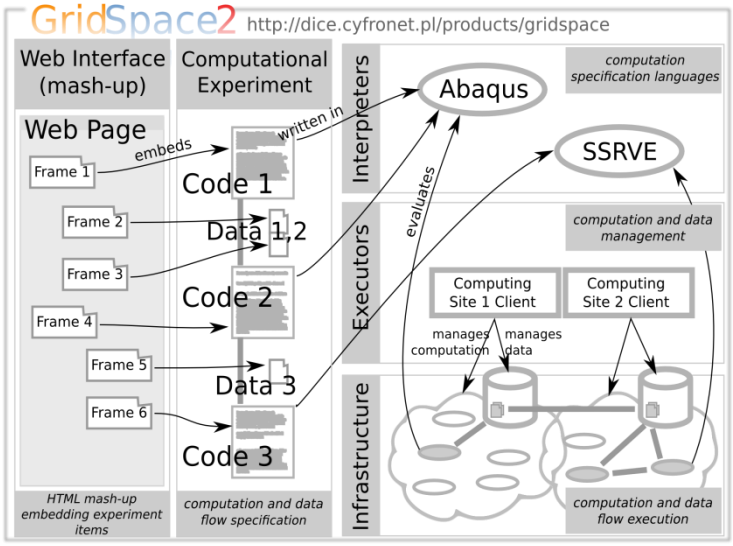
Concept of multiscale approach



Qualitative results



Computational experiment on GridSpace2 platform



Conclusions

Efficient multiscale modelling of sophisticated car body parts was presented in the paper. FE^2 approach with SSRVE concept in the micro scale was used for numerical simulations to improve computing performance. Due to this solution the time required for calculations in the micro scale was significantly reduced. Applied solution of mapping multiscale application on grid infrastructure simplified exchange of data between scales and allowed to optimized computational efficiency.

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Acknowledgements

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