Advances in simulation and modelling of metal forming

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Abstract

EU elaborated an ambitious program called Industry 4.0, with the aim of initiating a new industrial revolution. Virtual fabrication seems to be the fundamental tools for doing science and engineering in the mentioned program. This is one of the key ingredients for increasing the competitiveness of the European industry, by reducing the time from concept to market and by increasing quality and reliability of the final product. Pushing more and more tasks from the experimental testing and subsequent redesigning of a real prototype to the virtual testing of a virtual prototype reduces dramatically the research and development phase and the costs normally associated with hardware prototypes. In the metal forming industry an important part of the virtual factory is the numerical simulation of forming processes by finite element (FE) programs. The success of a FE simulation depends essentially on the accuracy of the constitutive models describing the plastic deformation and on reliable and robust identification of material parameters and a validation of the models. So, for identification of the constitutive models and validations of these models we need the material data. However, data alone are not enough to define an accurate model, being necessary some information and knowledge. Based on data, information and knowledge we can understand principles of the processes and thereby to generate the wisdom. The accuracy and applicability of metal forming simulation has been significantly progressed driven by the development of plasticity theory and numerics such as remeshing technique and contact analysis algorithm. The target of metal forming simulations emerges from the macro-scale analysis of deforming body into coupled analysis of deformations of deforming body and tools, and multi-scale analysis of microstructure and texture. The case examples of the simulations in metal forming processes are presented.