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On the application of SPH in the numerical analyses of short-duration dynamic phenomena

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Finite Element Method (FEM) – the most popular tool used today in many structures analyses – has number of well known limitations. One of them is its sensitivity to the deformation of finite elements. As a remedy to this problem, the whole family of so called meshless methods was developed [1, 2]. The oldest of these methods is Smoothed Particles Dynamics (SPH) developed by Monaghan [3] and Lucy [4]. Although, the first applications of the new method were in the field of astrophysics, it was quickly adopted for solving problems described by Navier-Stokes equations. Today, SPH is still widely used to analyse problems of solid mechanics [5].

Just like any other numerical method SPH has its problems and its successful application requires not only proper theoretical background but also a lot of experience. In the paper authors presented a few examples of SPH application in various mechanical problems. Effects of a different description of analysed bodies are also discussed.

The first example is devoted to a cutting of the layered flat sheet by the rigid object. Authors focused their attention on comparison of results obtained from SPH model, FEM model and experiment with the emphasis of the influence of meshed and meshless description of the material.

In the second example a deformation of the copper pulse shaper used in SHPB is analysed. The shaper was modelled using three different modelling techniques: FEM, SPH and a form of finite volume method. Again results obtained by different methods are compared against each other.

The last example presents application of SPH to describe erosion of brake pad surface due to friction . Usual approach to wear analysis is to use Archard or Reye law [6, 7] and thread wear as parameter. Although easy to implement in the analysis, this kind of modelling does not fully reflect physical phenomena responsible for surface erosion [8].

Above three examples cover different phenomena, which are difficult to analyse using FEM, i.e.: loss of cohesion, very large plastic deformation and erosion due to friction. Taking all above into account shows the improvement of modelling capabilities, which can be gained by the joint use of different numerical methods.

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