Nonsmooth Problems with Applications in Mechanics
Olomouc, Czech Republic, May 19-23, 2025

Elastic Body Simulation under Real-time Regime

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Abstract: We present an approach to elastic bodies simulation in a real-time physics engine software. In the talk we focus on the application of the St. Venant-Kirchhoff stress tensor in the deformable body dynamics simulation. Then we proceed to the implementation of the Finite Element Method in discretisation of an elastic body in three-dimensional space and explain how to numerically solve a specific system of partial differential equations. In addition, we examine a couple of setbacks that arise in the process of the simulation design such as numerical instability, linearisation or the boundary condition definition. In order to better understand these issues, we explain what the "real-time regime" is and how it impacts the approach to the software design. Moreover, we move on to the interactions between rigid and elastic bodies as a variety of these problems often undermines the reliability of real-time simulations. The difficulty in modelling such contacts is caused by frequently occurring nonsmooth relations. Thus, a couple of cases are shown in an interactive mode during the presentation. In the end we discuss the design of BartaEngine `https://github.com/Bartanakin/BartaEngine` – software that exhibits the most important features of a real-time physics engine and is written in the modern C++ language. Our talk is partly based on Jernej Barbic's research [1] who is a leading scientist in computer graphics.

References

[1] Sifakis, E.,& Barbič, J., *Finite element Method Simulation of 3D deformable solids*, Morgan & Claypool Publishers 2016.