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A fast method to simulate virtual deformable objects with force feedback

Abstract

In this paper, we propose solutions to real time simulation and interaction of deformable objects in virtual reality. Firstly, we present LEM - Long Element Method, a method created for physically based simulation of deformable objects. LEM has been conceived specially for objects filled with fluids. Using Pascal's Principle and volume conservation, the method produces a static solution for global elastic deformation. Bulk variables such as pressure, density, volume and stress are used to model the deformable object. Secondly, we present a deformable buffer model that is used to solve problems arising from the difference between sampling and update rates. We look into the construction and the updating process of this buffer model. Our approach to linking the two models to get realistic force feedback is also presented. The physical and haptic model are then coupled to be part of a surgical simulator for soft tissue. We present some results from our prototype medical simulator for echography exams of the human thigh.

Keywords — Virtual reality, dynamic simulation, haptic interaction, physically based models, deformable objects.