



Project Proposal Template

Project Management and Software Development
for Medical Applications

General Info

Project Title: [Physically-Based Deformable Volume Rendering for Augmented Reality](#)

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Project Abstract

Physically-based deformation models can be combined with direct volume rendering techniques to create an interactive representation of volumetric data under real deformations. In this project, different deformation models will be implemented into a deformable volume rendering pipeline and their efficacy will be evaluated.

Background and Motivation

Volumetric representations play an important role in medical applications such as image registration, navigation or surgical planning. The data is mostly given by CT or MRI scans encoding the biological tissue distribution of different anatomical structures. Many of these structures are soft and inherently deformable. Visualization techniques such as direct volume rendering are mostly limited to displaying static data and cannot handle deformations. Applying physically-based deformable models before rendering can overcome these limitations by calculating a deformation field and applying it to the volume before rendering. Existing approaches are either based on meshing the volumetric data and rendering a deformed tetrahedral mesh, or resampling the data onto a regular grid after deformation. In this project, different deformation models such as ChainMail, Mass-Spring, and FEM

will be compared in terms of accuracy, speed, and performance under large deformations for application in a deformable volume rendering pipeline.

Student's Tasks Description

The student will implement different deformable models such as ChainMail, Mass-Spring, and FEM on volumetric datasets. The approaches will be evaluated in terms of their potential for real-time augmented reality applications.

Technical Prerequisites

Required:

- Strong experience with C++ and OpenGL
- Strong mathematical background

Beneficial:

- Knowledgeable in physical simulation frameworks such as SOFA
- Experience with GPGPU (CUDA or OpenCL)

References

[1] Aguilera, A.R., Salas, A.L., Perandr s, D.M. and Otaduy, M.A., 2015. A parallel resampling method for interactive deformation of volumetric models. *Computers & Graphics*, 53, pp.147-155

Please send the completed proposal to b.busam@framos.com. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.