Contact Stress Analysis in OpenFOAM: Application to Hip Joint Bones

Philip Cardiff

Supervisors: Alojz Ivanković, David FitzPatrick, Aleksandar Karač
Presentation Outline

Research Background
Development of a Contact Stress Solver
Development of a Hip Joint Model
  CT Segmentation
  Meshing
  Stress Analysis
  Gait Analysis
Research Background
Anatomical Background

- Intact muscles
- Ligaments
- Small head
- Sutured muscles
- Ligaments
Development of a Contact Stress Solver
Slave vertex penetration - close-up view
Slave vertex force

slave vertex force (N)

4e+6  8e+6  1e+7

0   15000001
Slave traction - applied boundary condition
Sphere-and-Brick test case
Sphere-and-Brick test case
Contact Stress Analysis - contact validation

Abaqus

OpenFOAM
Contact Stress Analysis - contact validation
Frictionless sliding

![Diagram showing stress distribution with a color scale ranging from -1.43e+07 to 9.07e+05.](image)
Frictionless sliding - 3D
Parallelisation

![Parallel speed-up graph]

- **Hypothetical linear parallel speed-up**
- **OpenFOAM contact solver parallel speed-up**
Development of a Hip Joint Model
CT Segmentation
Volume meshing - polyhedral mesh
Material assignment
Contact Stress Analysis - 2D hip joint model

Abaqus

OpenFOAM
Contact Stress Analysis - 3D hip joint model

Abaqus

OpenFOAM
Contact Stress Analysis - 3D hip joint model

Abaqus homogenous model

Abaqus sandwich model
Gait Analysis
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Thanks