Real-time Simulation of Suturing on deformable models

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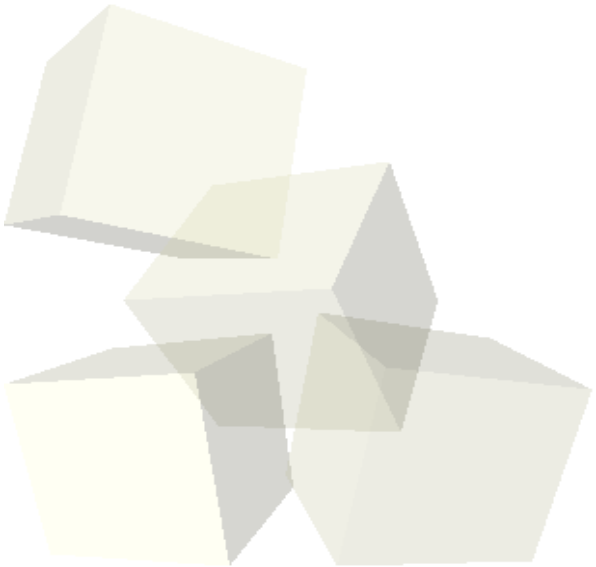
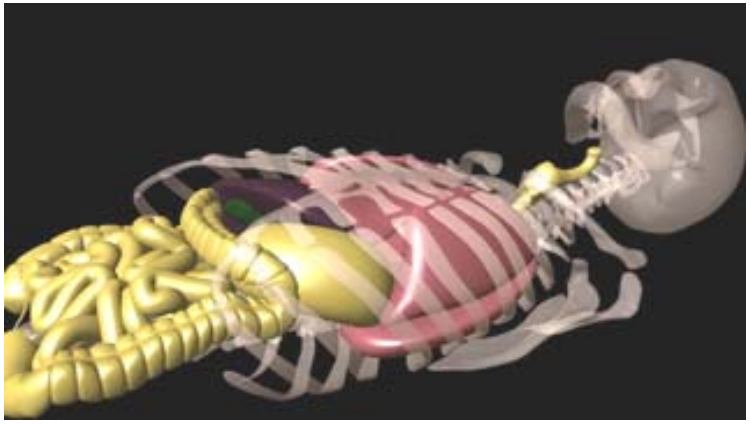


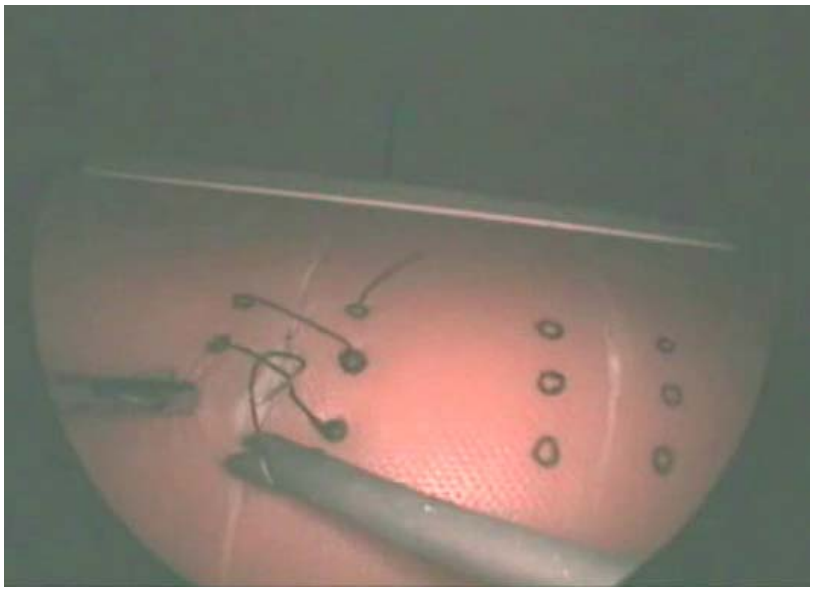
The team

- Ph. D. student in the GRAPHIX team (Alcove project)
- 40 people
- Area of research : interaction with complex 3D objects
- 2 applications : simulation of sophisticated surgical protocols & collaborative virtual environments
- Developments are done in SOFA - Simulation Open Framework Architecture – in collaboration with other INRIA projects (Asclepios & Evasion)



My subject

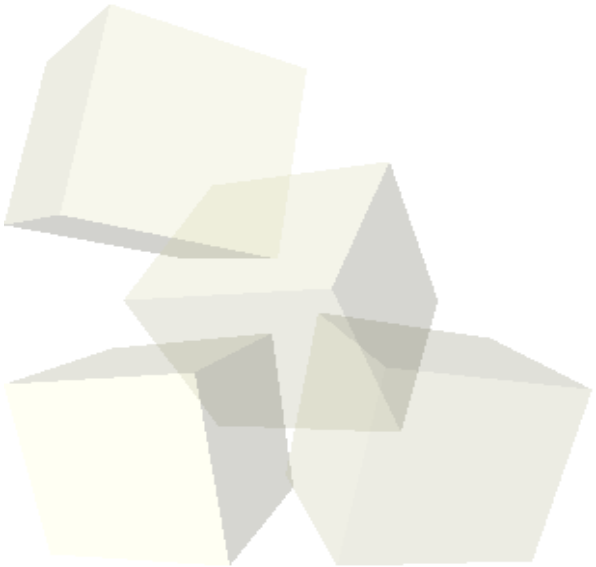
- Simulation of suturing tasks for surgical applications
- Using soft bodies
  - Various elastic properties
- As close as possible to the real behaviour
- Real time

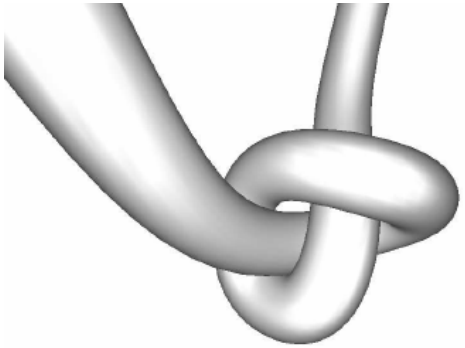


Roadmap

- Full simulation of the suturing process requires :
  - Soft bodies model capable of simulating organs
  - Stable collision detection and response
  - Surgical thread model, with knots tying
  - Sliding constraints for the thread / organ interaction
  - Clever optimization to achieve real time simulation

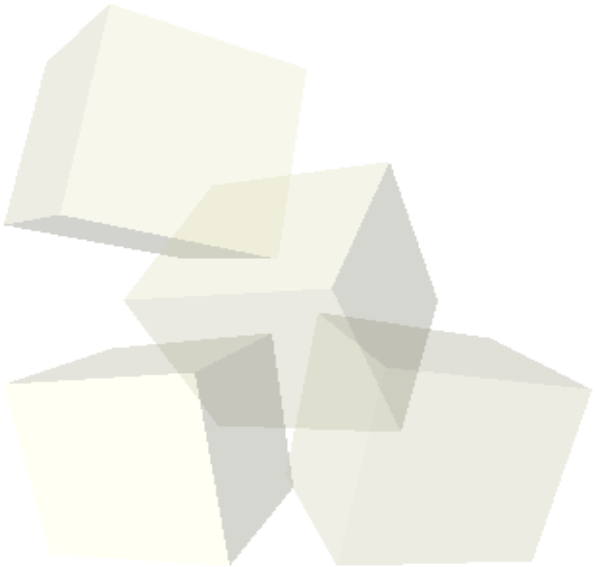
- Bonus : allowing cutting of the soft bodies model

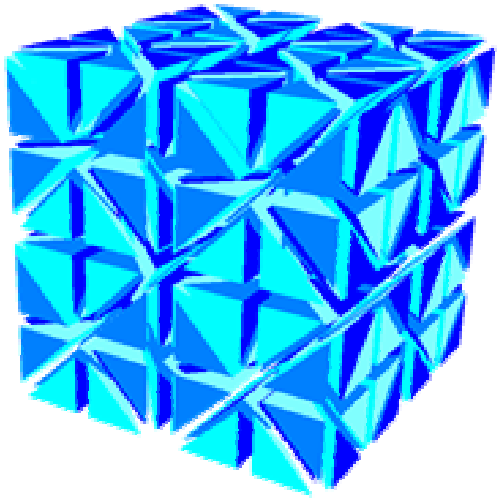


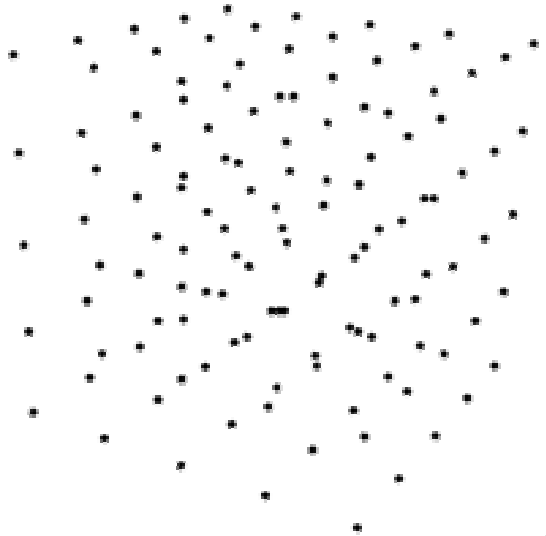


Deformable model

- Most common : Finite Elements Model
  - The object is decomposed into smaller elements (e.g. tetrahedrons) whose elastic comportment is well known
- My choice : Meshless Model
  - The object is modelled by a point cloud, no explicit structure
  - Each particle (phyxel) has a specific influence on its neighbours
  - Another discretization method for continuous medium laws
  - Drawbacks : slower simulation
  - Benefits : simpler topological modifications (cutting, fusion)

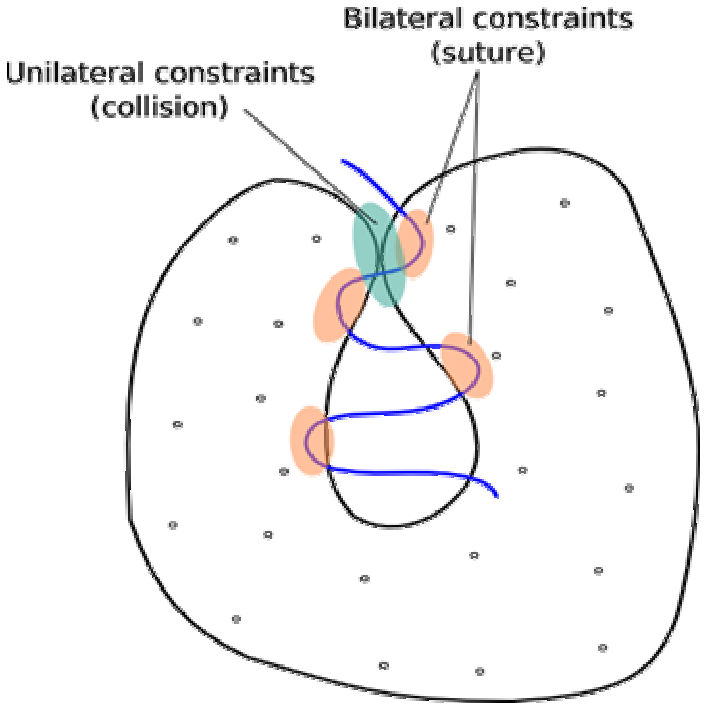






Constraints

- Near future : work on the constraints
- Also, repartition of forces and constraints applied to the surface of the object to the phyxels of the meshless model
- Uses :
  - Collision response
  - Suture : chirurgical thread sliding through the organ



Thank you for your attention

Any questions ?