Mass-spring Cloth Simulation with Shape Matching

Tzvetomir Vassilev
Dept of Informatics&IT
University of Ruse, BG

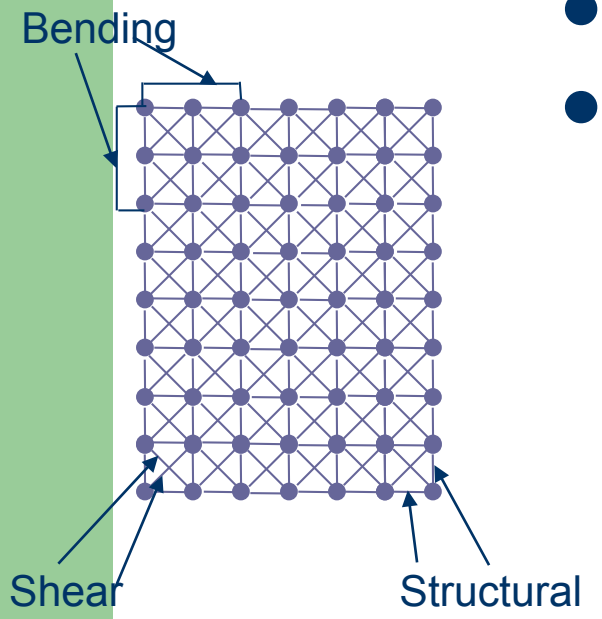
Topics of Discussion

- Aim of This Work
- Cloth Model
- Collision Detection
- Implementation and Results
- Conclusions

Aim of The Work

- The aim of this work is to speed up and improve mass-spring cloth simulation used for virtual try-on with hardware accelerated ray-tracing for collision detection

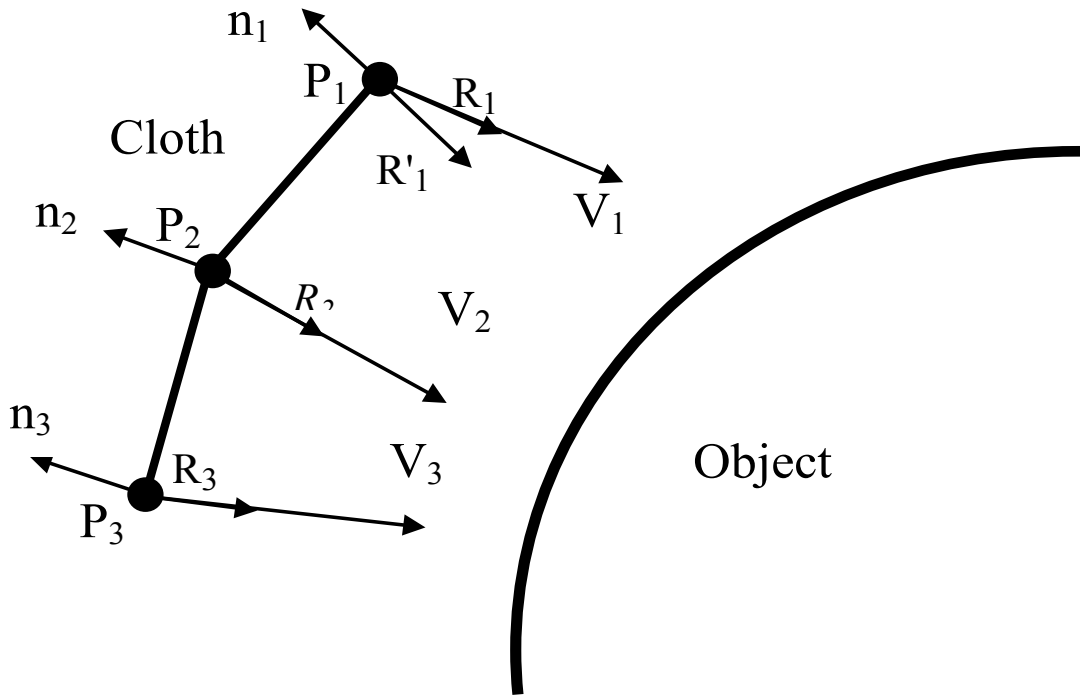
Mass-spring Cloth Model



- A grid of masses with springs
- Forces: $\mathrm{f}_i = m\ \mathrm{a}_i$,
  - internal:
    $$\mathbf{f}_{int\,i}(t) = -\sum_j k_{ij}\Delta\mathbf{l}_{ij}$$
  - external:
    - gravity: $\mathrm{f}_{gr}(\mathrm{p}_i) = m\ \mathrm{g}$
    - damping: $\mathrm{f}_{vd}(\mathrm{p}_i) = -\ C_{vd}\mathrm{v}_i$
    - seaming
    - collision detection
- Verlet integration on GPU with CUDA

Collision Detection

- A collision ray is constructed (R1) for each cloth vertex
- NVidia OptiX is used to trace the ray



Implementation and Results

- Windows, NVidia GeForce RTX 2070 graphics card using NVidia Optix 6.5.
- Cloth simulation, collision detection and response were performed on the GPU
- Iteration time: 0.815 ms with RTX acceleration vs 0.975 without

Results: Layers of cloth

Conclusions

- The Verlet integration does not speed up the simulation significantly compared to Euler integration.
- The collision detection can be accelerated significantly taking advantage of the hardware implemented ray tracing on the new NVidia RTX cards. Results show that this increases performance by 20%.
- Due to the highly parallel architecture of the NVidia RTX GPU the simulation speed does not depend on the number of cloth vertices.

Contacts

- TVassilev@uni-ruse.bg

Thank you for your attention!