Real-Time Musculoskeletal Model for Injury Simulation on 3D Human Characters

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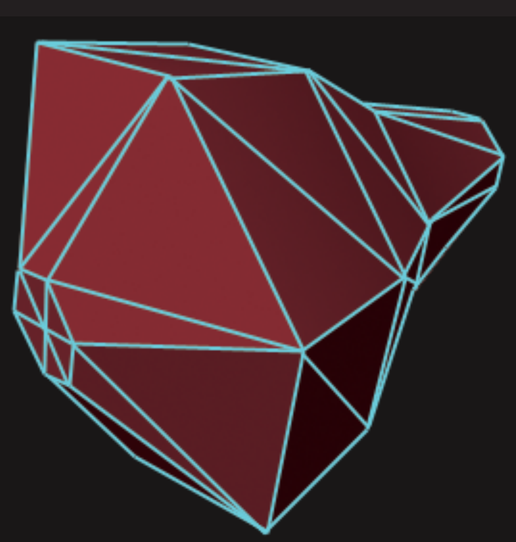
Research

We study how certain physical injuries can be approximated and simulated in real-time on virtual human characters in a 3D environment.

Goals

1. Design a musculoskeletal model prone to localized damage for a real-time engine.
2. Design an injury assessment model useful for motion editing.

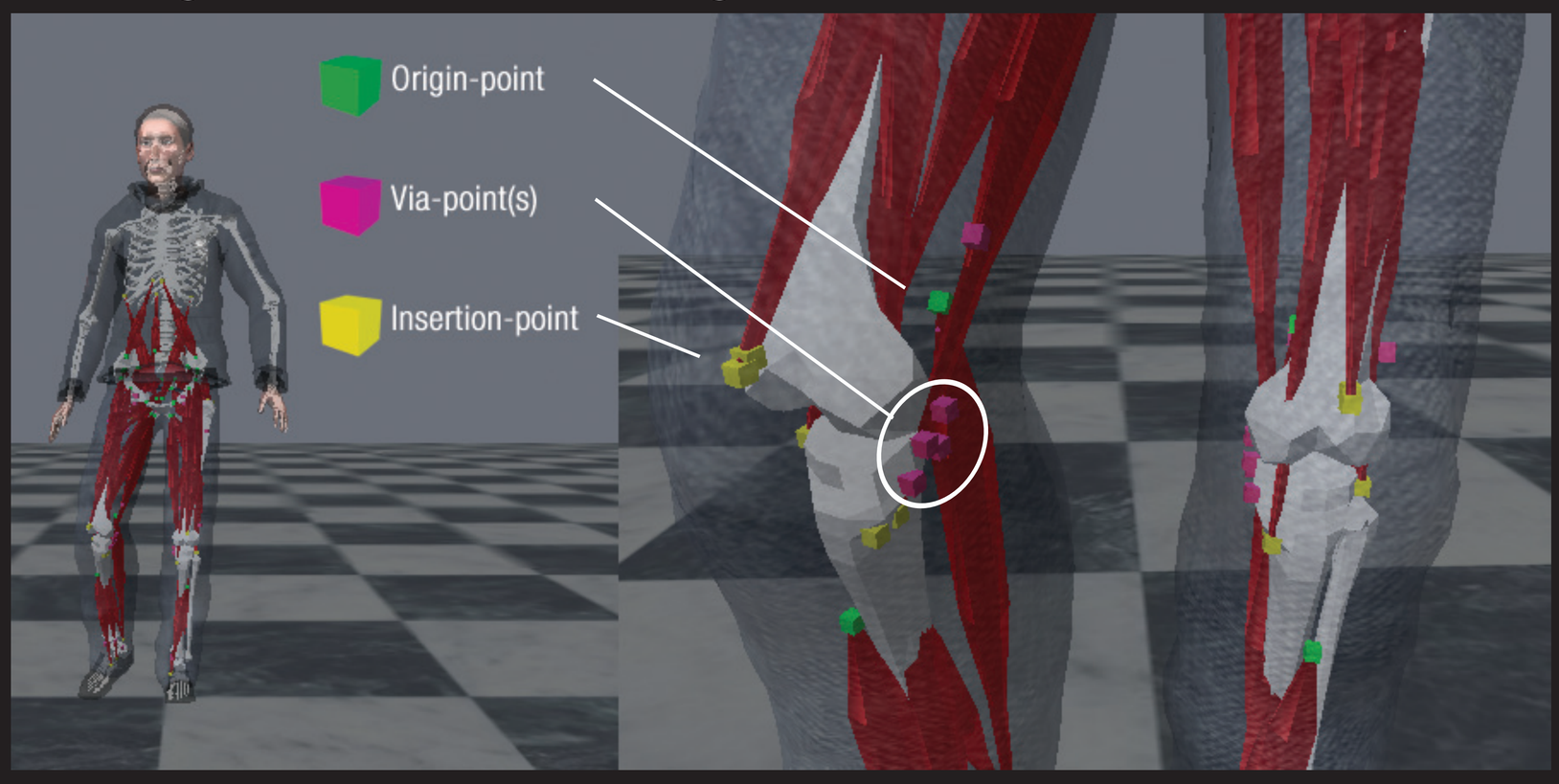
Muscle Shape



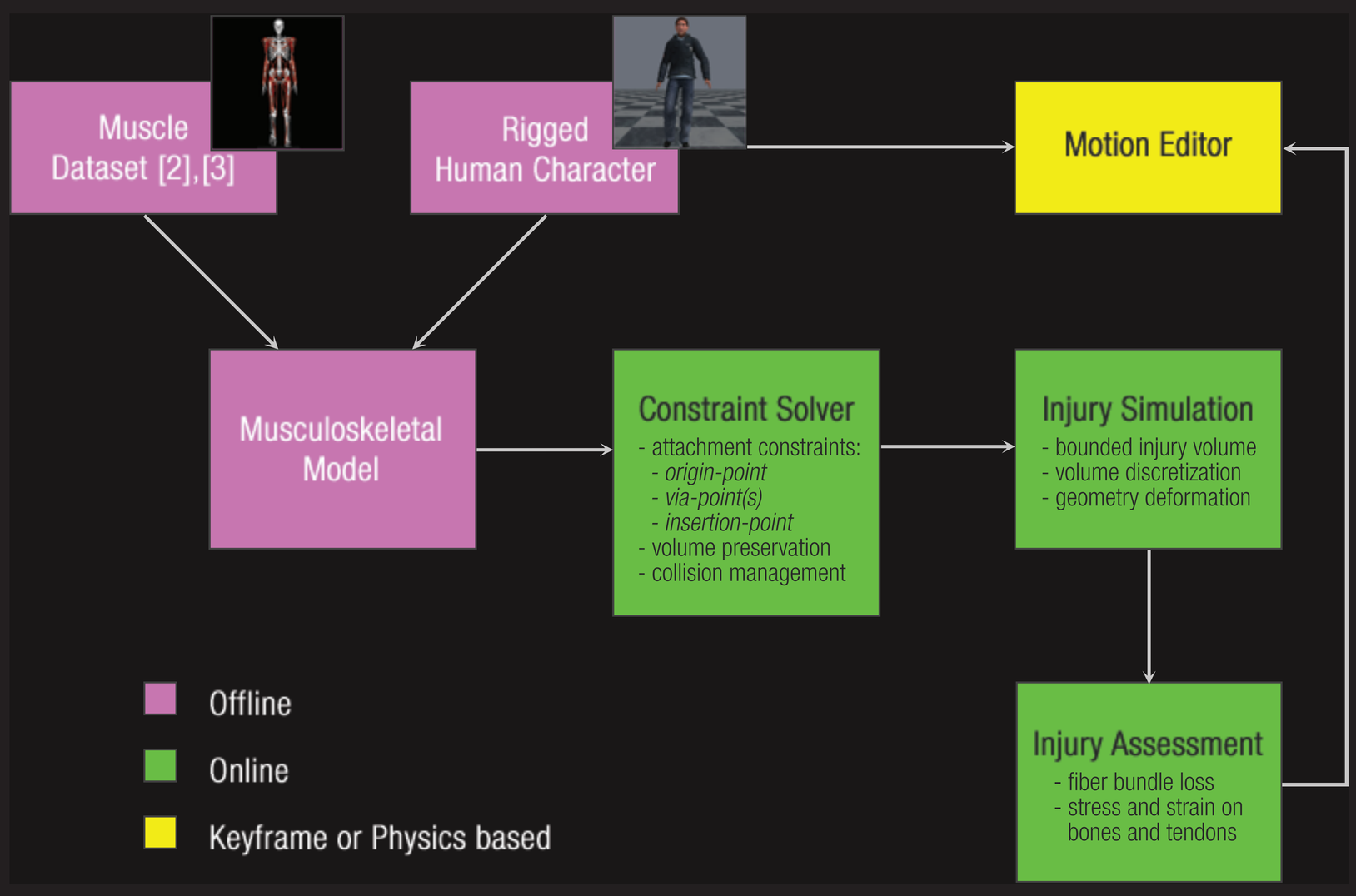
Currently we use a cylinder based template similar to the work of [1]. Each cross-section is placed at relative via-point positions that are defined in the data from [2]. More cross-sections can be dynamically added to increase or decrease the amount of shape smoothness. The radius of each cross-section can be modified in real-time for volume preservation and collision management.

Musculoskeletal Model

Our musculoskeletal model is inspired by work of [2], [3] and consists of attachment points, maximum isometric forces, pennation angles, optimal fiber lengths, and tendon slack lengths for each muscle.



Pipeline



References

[1] Wilhelms, J., Van Gelder, A.: *Anatomically Based Modelling*. (1997)

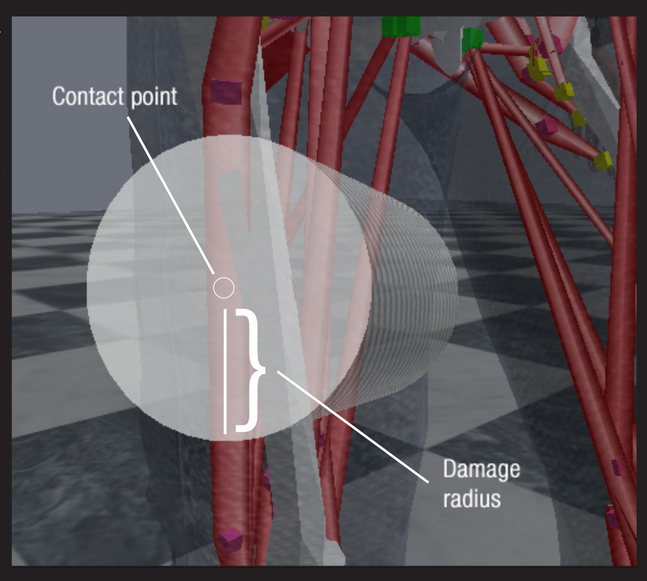
[2] Delp, S.L., Anderson, F.C., Arnold, A.S., Loan, P., Habib, A., John, C.T., Guen- delman, E., Thelen, D.G.: *OpenSim: Open-Source Software to Create and Analyze Dynamic Simulations of Movement*. Transactions on Biomedical Engineering 54, No. 11 (2007)

[3] Menegolo, A.: *Upper and Lower Body Model*, `https://simtk.org/home/ulb_project` (2010)

Injury Simulation

For injury simulation, the focus lies currently at projectile based injuries for the base experiment and validated against research from the field of ballistics. Our plan is to simulate the following injuries:

- Ballistic trauma
- Bone fractures
- Muscle/Tendon strains



Acknowledgement

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