

Modeling the Deformation of a Golf Ball

A Ball-Spring Simulation

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Introduction

- What is a force?
- Deformations



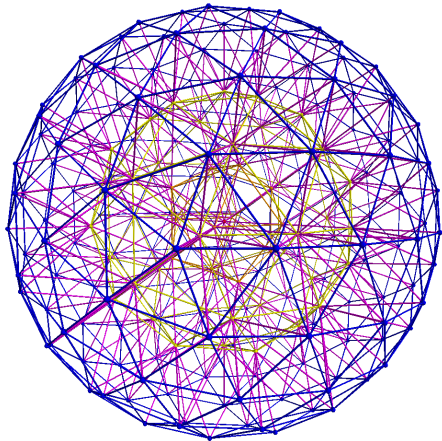
A United States Golf Association (USGA) video of a golf ball hitting steel at 150 mph

Two difficulties in simulating:

1. Making the model
2. Adding the physics

Making the Model

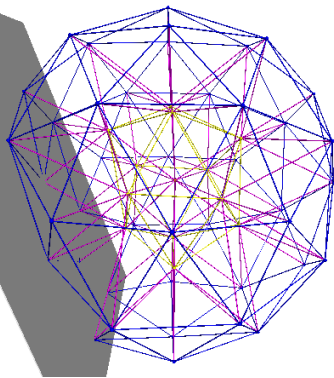
- Geodesic spheres
- Layers
- Connections of particles



The final model

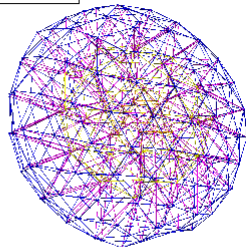
Adding the Physics

- Springs
- Revised momentum principle



My model being compressed by a “club”

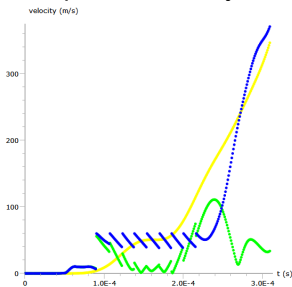
$t = 0.000384$



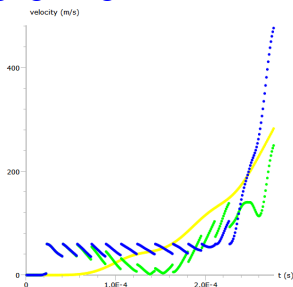
My model flying shortly after being hit

Results

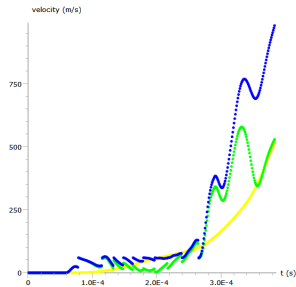
Graphs of velocity of **edge getting hit**, **the center of mass**, **the difference**



Loft of 0°



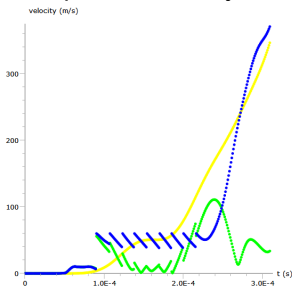
Loft of 20°



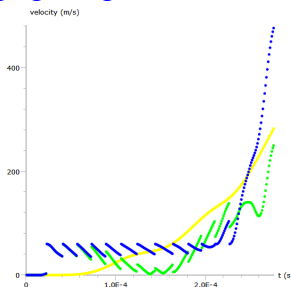
Loft of 51°

Results

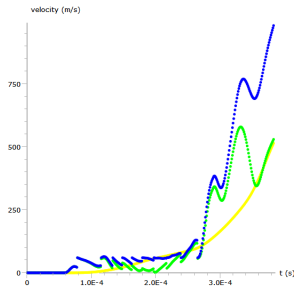
Graphs of velocity of **edge getting hit**, **the center of mass**, **the difference**



Loft of 0°



Loft of 20°



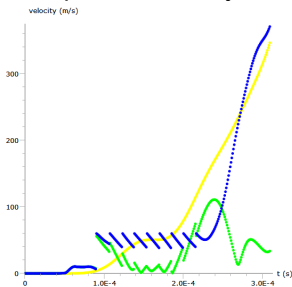
Loft of 51°

The good parts:

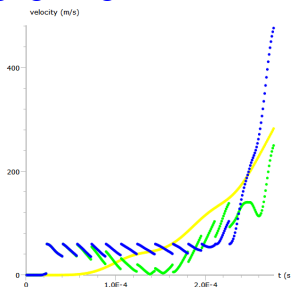
- Spin
- Speed relative to each other

Results

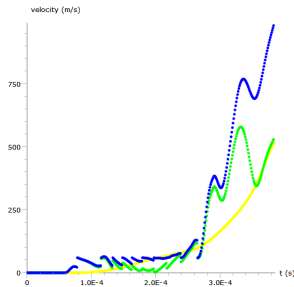
Graphs of velocity of edge getting hit, the center of mass, the difference



Loft of 0°



Loft of 20°



Loft of 51°

The good parts:

- Spin
- Speed relative to each other

The bad parts:

- Speed quantitatively
- Acceleration

Conclusions

- ✓ Deformation
- ✓ Spin

Conclusions

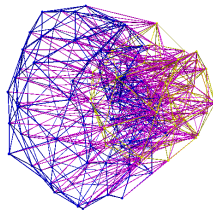
- ✓ Deformation
- ✓ Spin
- ✗ Verification/Validation
- ✗ Stability

Conclusions

- ✓ Deformation
- ✓ Spin
- ✗ Verification/Validation
- ✗ Stability



Flattening



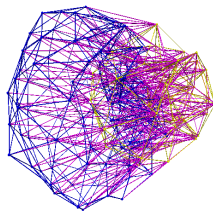
Collapsing

Conclusions

- ✓ Deformation
- ✓ Spin
- ✗ Verification/Validation
- ✗ Stability



Flattening



Collapsing

The ultimate question: *How do we debug nature?*