# CS599 Physically Based Modeling for Interactive Simulation and Games

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# Haptics

## 1.1. Definition

Haptics is a study of sense of touch. Word haptic is from a word 'sense of touch' in Greek. Humans have 5 senses. Study of eye sight is graphics. Study of touch is haptics. The end goal of the haptics is creating illusion of touching something.

## 1.2. Properties

Needs special hardware. General procedures are following

Collision detection (of rigid objects)→ Simulation → Calculate forces

From the kinesthetic sensors, we need to simulate tactile sense.

    (a) kinesthetic sensor: detects bodily position (i.e. joint angels)
    (b) tactile sensor: sense of texture

Simulating tactile senses requires safety concerns. Pushing against hard wall is an example. Because it concerns big forces, mechanics is difficult and it requires high update rates to stabilize. Therefore, it is hard to simulate a stiff wall.

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Haptic devices are usually described by degrees of freedom (DOF). DOF is further divided into DOF for positional sensing and DOF for haptic feedback.

Simple examples of haptic applications are medical simulations (i.e. surgery training) and golf swing simulations.

## 1.3. Case study:Six-DoF Haptic Rendering of Contact between Geometrically Complex Reduced Deformable Models

(a) Jernej Barbic and Doug L. James: Six-DoF Haptic Rendering of Contact between Geometrically Complex Reduced Deformable Models, IEEE Trans. on Haptics, 1(1), 2008, p. 39-52
(b) Jernej Barbic and Doug L. James: Time-critical distributed contact for 6-DoF haptic rendering of adaptively sampled reduced deformable models, ACM SIGGRAPH / Eurographics Symposium on Computer Animation (SCA) 2007, San Diego, CA, August 2007, p. 171-180

Complex geometry vesus complex geometry collision is a time consuming problem. The papers give a solution in real-time in stable manner with an deformable object by introducing distance fields and auto-adjustment of sample points.

Example of Buda and dragon collision is given as a complex geometry versus complex geometry collision example. For collision model, dragon is represented by sample points (point shell), and it is deformable, and Buda is represented as preprocessed signed distance field. From these representations, we can compute contact forces in real-time. Also adjust number of sample points for real-time computation.

Cold GD: 4000 | Warm GD: 5000 | Tree: 341001
Tree nodes processed: 2747
Points in contact: 524
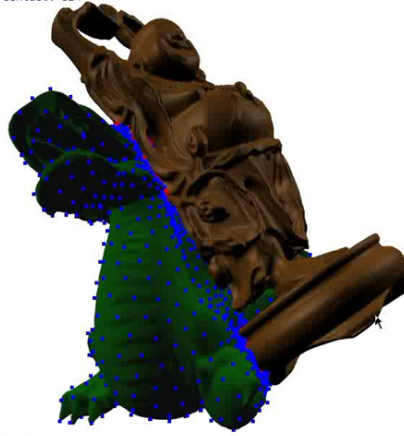
Graphics: 20 Hz
Haptics: 997 Hz
Microsecs: 0935
LOD: 3

**Figure 1.** Collision of a dragon and Buda