Simulation of Human
Sensory-motor Reaction

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About the Project
The haptic interaction system forms a closed loop where the human action is regarded for the haptic simulation which then produces a force feedback that affects the behaviour of the hand. A plausible model of the behaviour of the human reaction to a computed feedback is necessary for many purposes in the research of computer generated haptics.

Applications
We currently look at the use of human reaction models for the purpose of improving haptic deformation models. There are many applications of such models in this process:

Comparison — to provide both objective and reproducible input and interaction behaviour so that different algorithms can be compared.

Off-line Testing — for testing haptic feedback algorithms when on-line tests are not acceptable, for example when the necessary equipment is not available or in danger of being damaged, or if the human operator would be in danger.

Development and Adjustments — providing a laboratory environment with fully controlled interaction for testing a systems behaviour with varying parameters such as speed, demographic properties and other parameters.

Spring-Damper Feedback
Convincing surfaces can be rendered using a simple spring-damper coupling between a proxy point and the haptic instrument.

Deformation Simulation
Realistic force feedback from deformable objects can be simulated using methods such as the finite elements method, FEM.

Passive Human Behaviour
The model over the passive human operator would model only the physical behaviour of the body. Since the body normally exhibit both conscious and subconscious reaction, this model would only be valid at frequencies where such reaction does not occur.
- Linear behaviour
- Frequencies over 20 Hz

Active Human Behaviour
The model over the active human operator would have to model both the physical behaviour of the body and the conscious and subconscious reaction to the force feedback.
- Non-linear behaviour
- Conscious actions
- All frequencies (typically 1–1000 Hz)

Since the conscious actions are to be modelled, we need some standardization of the intended action. In normal interaction with surface objects two normal actions are typically followed:
- Force consistency — the hand is moved so that the sensed force is constant, typically to trace the global shape of an object
- Constant position — the hand is moved so that its position follows a predetermined pattern, for example applying a constant deformation