

haptics

technology and applications

September 2007

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who we are

provider of haptic technology

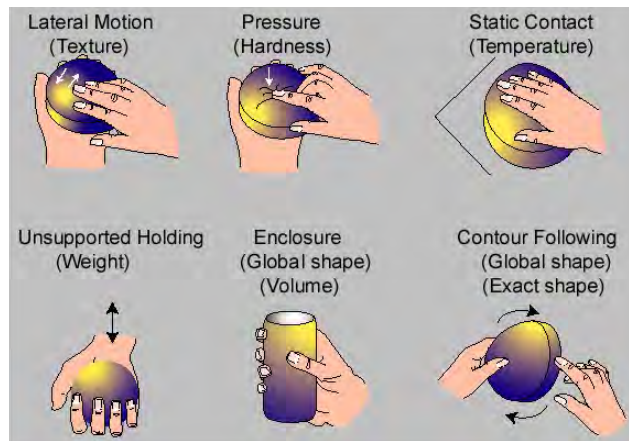
- | more than 12 years of cutting-edge haptic research
Swiss Federal Institute of Technology, Lausanne (EPFL)
- | founded in 2001
located in Lausanne, Switzerland
- | multi-disciplinary expertise
mechanics, electronics, control
and software engineering
- | outsourced operations
precision manufacturing
made in Switzerland



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what is haptics

from Greek “*haptesthai*” = to touch

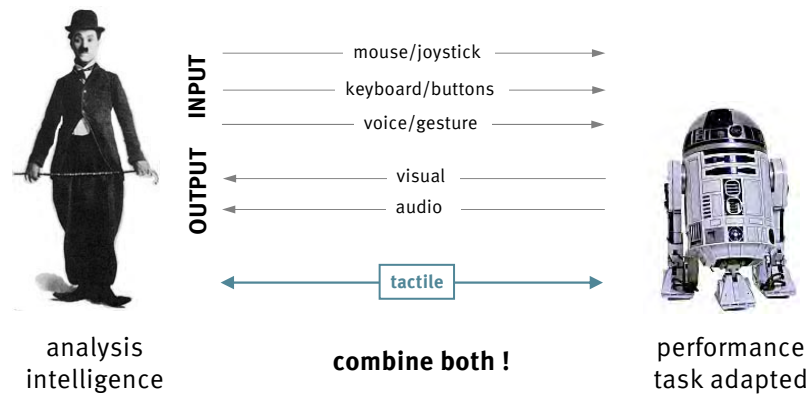


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overview

human – machine interaction

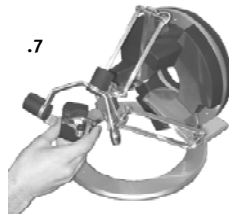


standard products

universal haptic devices

| Omega.3

I.D.
2005 Annual
Design Review
Winner



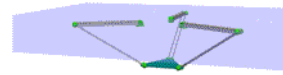
| Delta 3DOF / 6DOF



what we do

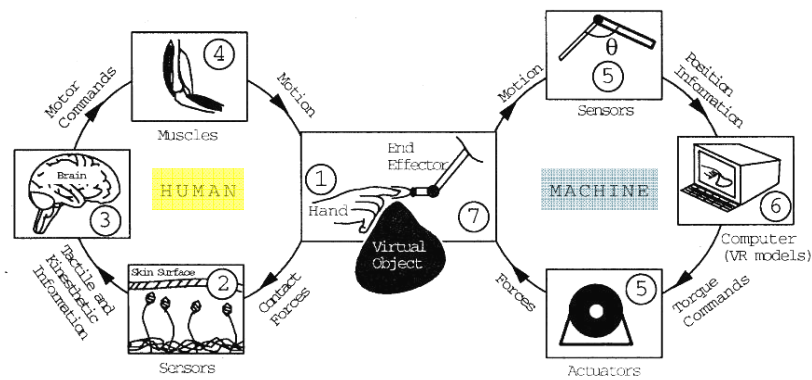
our services

- | custom design of haptic interfaces
- | software integration
Windows, Linux, Apple
- | end-user solutions
Haptic & Graphical User Interface (H-GUI) design
force feedback integration
- | **OEM**
manufacturing
licensing
medical field

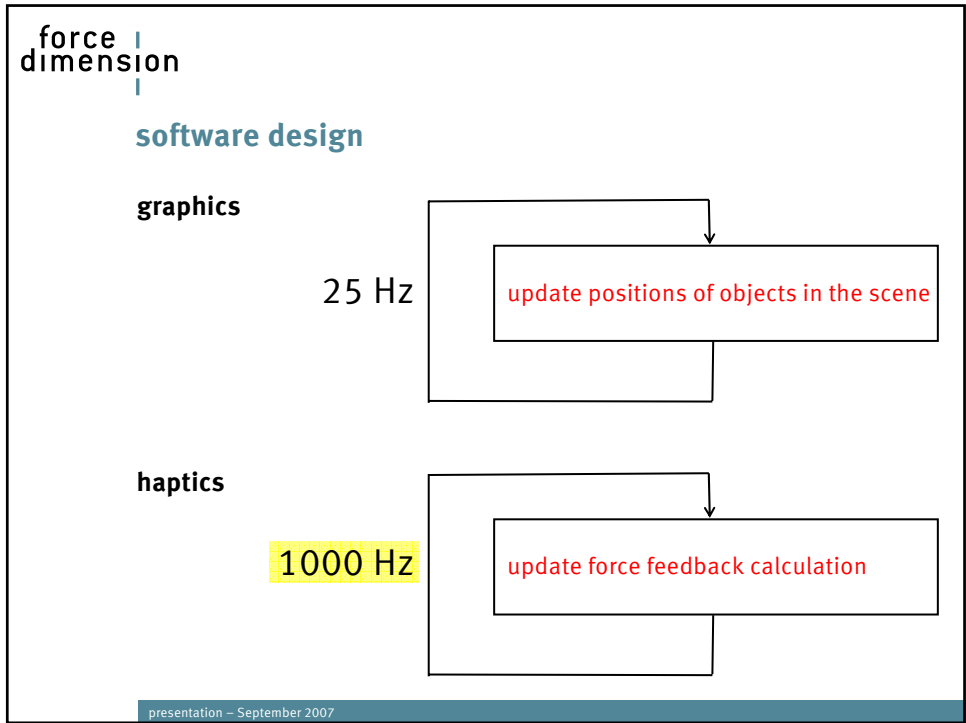


haptic technology

haptic interaction control loop




courtesy Mandayam Srinivasan, MIT



force dimension


software design

some haptic objects types

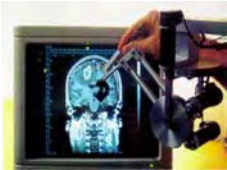


Implicit Surfaces

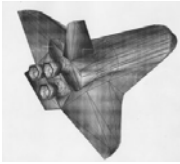
$$S(x,y,z) = (2x^2 + y^2 + z^2 - 1)^3 - (0.1x^2 + y^2)z^3$$



Volume Representations (voxel)



Potential Functions



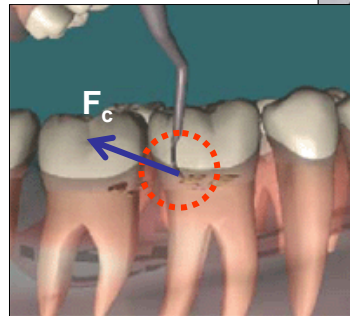
Polyhedral Surfaces

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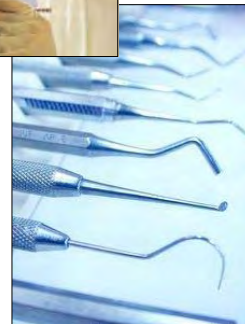
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medical training

dentist simulator



EVL / Cristian J. Luciano

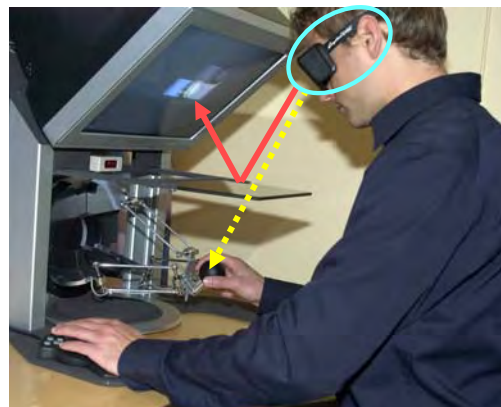


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immersive displays

with 3D stereo vision and hand - image collocation



SenseGraphics

reachin

Force Dimension - applications

robotics



haptic telemanipulation

- | control a “slave” robot using a haptic “master” input device
 - industrial robot arm
 - manipulator (micro-manipulator, nano-manipulator, crane, ...)
 - mobile robot or vehicle (submarine, aircraft, ...)
 - ...
- | force feedback computed from any sensor on “slave” robot
 - force sensor
 - range or distance sensor
 - ...



Stanford University

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robotics

advantages of haptic robot control

- | remote operation
 - environment hostile to humans
 - environment inaccessible to humans
- | force scaling
 - increase human sensitivity
 - increase human strength
- | geometrical scaling
 - increase human precision
 - increase human motion range
- | user “feels” the environment
 - keep slave robot away from obstacles
- | add haptic information
 - guide user’s hand along a trajectory
 - orient slave robot tool in correct direction
 - prevent user from going in dangerous regions
 - filter user’s tremor

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robotics

advantages of haptic robot control

- | intuitive 3D/6D control

=> the result is **fast**, **safe** and **efficient** teleoperation

=> **high-quality** haptics is required for **accurate** and **reliable** teleoperation

=> large field of potential applications !

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medical applications

3 types of interactions

- | simulation (training)

- | teleoperation (remote)

- | gesture guidance (haptically augmented reality)

key parameters

- | precision

- | reliability

- | user-friendliness (ergonomics)

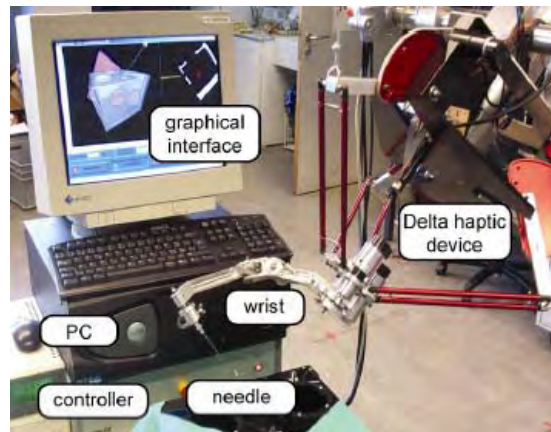
=> **acceptance from the medical community !**

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gesture guidance

biopsy navigator



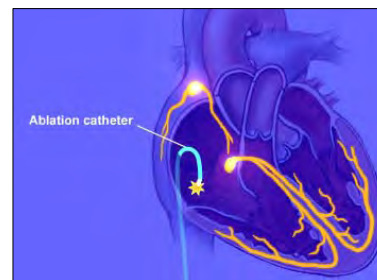
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medical control interface

radiofrequency catheter ablation

- | stroke risk increased by atrial fibrillation
stroke is 3rd leading cause of death in the US
- | heart beat disorders
arrhythmia
tachycardia => **potentially dangerous !**
- | carefully destroy abnormal areas
ablation catheter tip
delivers radiofrequency energy
- | minimal invasive procedure
requires high precision and reliability



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medical control interface

steerable guide catheter

- | move catheter tip in 3D inside heart chamber



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medical control interface



robotic catheter system : received FDA approval



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**have a demo
thank you !**

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