

Introduzione alla Realtà Virtuale Parte II

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Sommario



- Introduzione
- Sistemi di Input
- Generatori di mondi
- Motore di calcolo
- **Sistemi di Output**
- Conclusioni

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Sistemi di Output::display aptici



Haptic displays



Convey to the subject the sensorial information generated in the interaction with the virtual objects: force, material texture...

Measure the force exerted by the subject on the virtual environment.

Aptic displays provide a mechanical interface for Virtual Reality applications.

Most important developments have been made in the robotics field.

International Haptic society - <http://www.isfh.org/>



Cyber grasp



Cyber Grasp:

- max 12 N per dito
- Peso 350 grammi



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Requirements of Haptic displays



- Large bandwidth.
- Low inertial and viscosity.

Technological solutions (oggetto intermediario):

- Direct drive manipulandum (Yoshikawa, 1990), Phantom (2000).
- Parallel manipulandum (Millman and Colgate, 1991; Buttolo and Hannaford, 1995).
- Magnetic levitation devices (Salcudean and Yan, 1994; Gomi and Kawato, 1996).
- Gloves (Bergamasco, 1993).

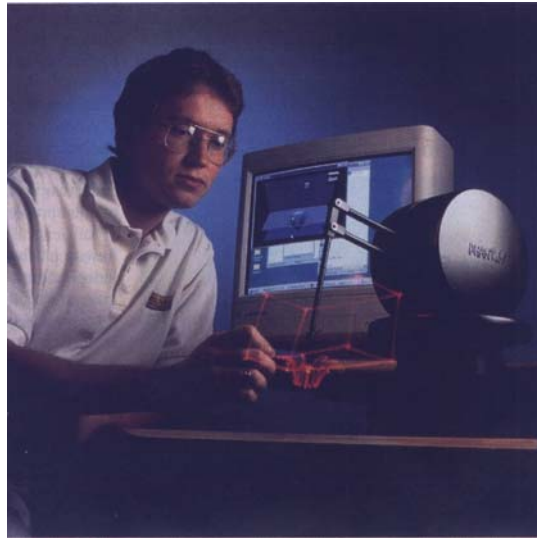
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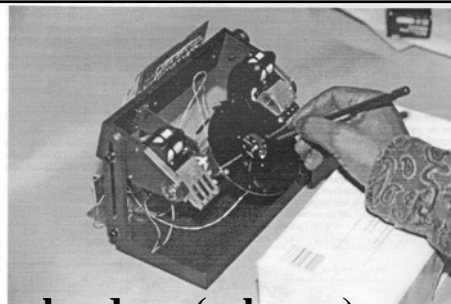
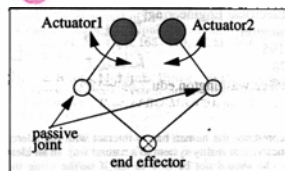
Direct drive manipulandum (phantom)



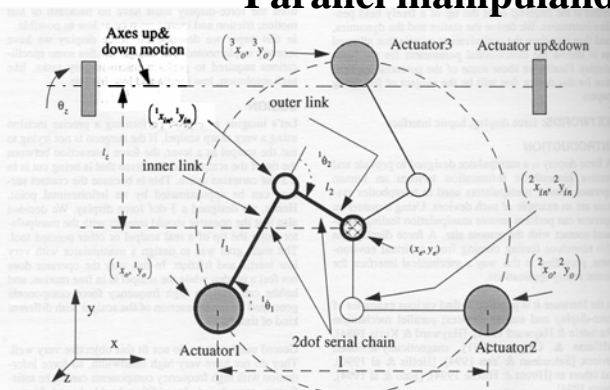
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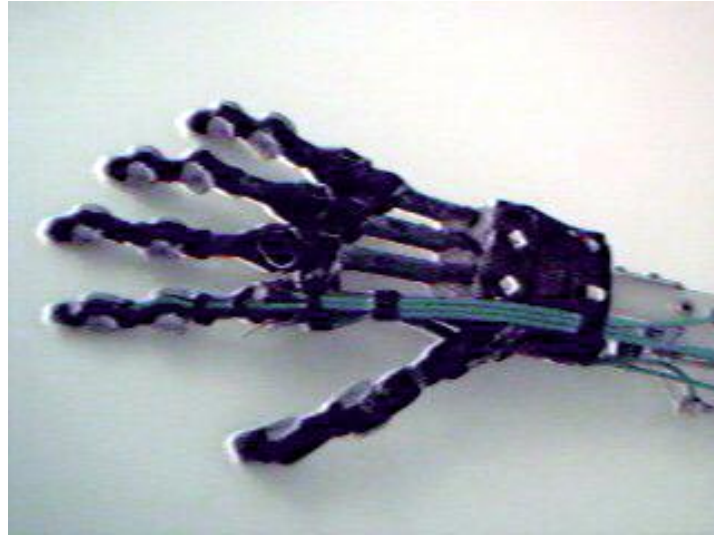
Parallel manipulandum (schema)



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Gloves (Blackfinger, 2000)



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Percro gloves (2002)



Sensori goniometrici – non devono essere calibrati sulla lunghezza delle falangi.

<http://www.percro.org>

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Sistemi di Output::display



Optical Output systems



Requirements for the monitor:

- Large field of view ($180^\circ \times 150^\circ$).
- High spatial resolution (35 pixels/degree, equivalent to 12,000x12,000 pixels for a 19" display positioned at 70cm from the viewer).

Requirements for the world generator:

- Stereoscopic vision for objects with $D < 10m$.
- Monocular cues for objects with $D > 10m$.
 - - Occlusions.
 - - Geometrical perspective and a-priori model knowledge.
 - - Shading.
 - - Motion.



La camera come strumento di ripresa



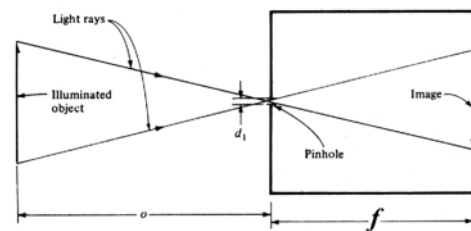
Come si forma un'immagine?



- Scena con oggetti riflettenti.
- Sorgente di illuminazione
- Piano di rilevazione della luce riflessa.

Il motore di questa trasformazione è la **proiezione prospettica**.

Modello pin-hole



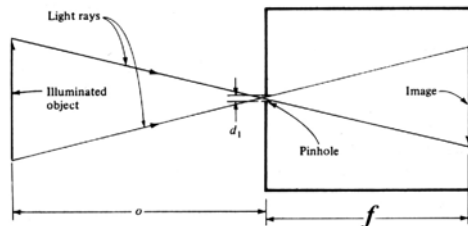
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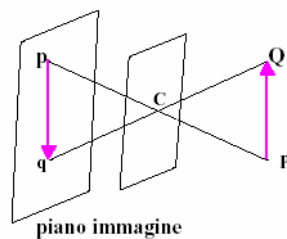
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La pin-hole camera



Proiezione prospettica: tutti i raggi di proiezione passano per un unico punto, detto **centro di proiezione**.



Pinhole camera

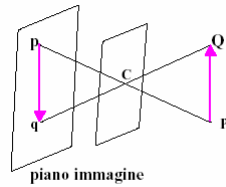
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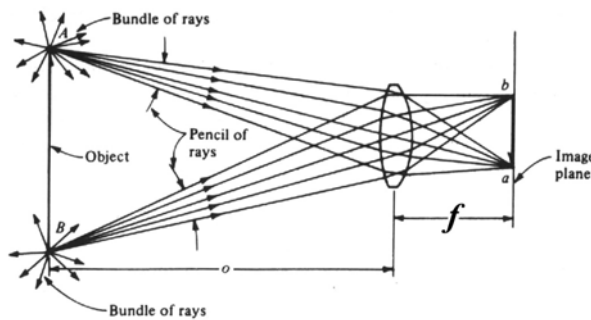
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La lente



Pinhole camera



Lente convergente

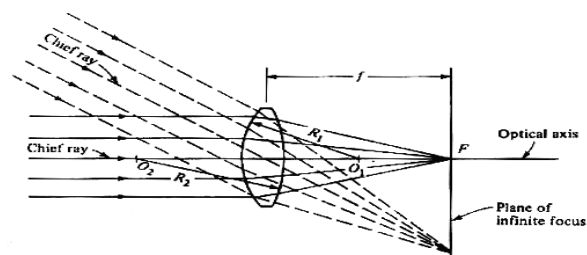
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Geometria dell'ottica



Oggetti all'infinito

- **Distanza focale:** distanza del piano immagine quando un oggetto si trova all'infinito.
- **Asse ottico:** raggio che non viene deviato dalla lente.
- **Intersezione dell'asse ottico con il piano immagine dà il punto principale (F).**

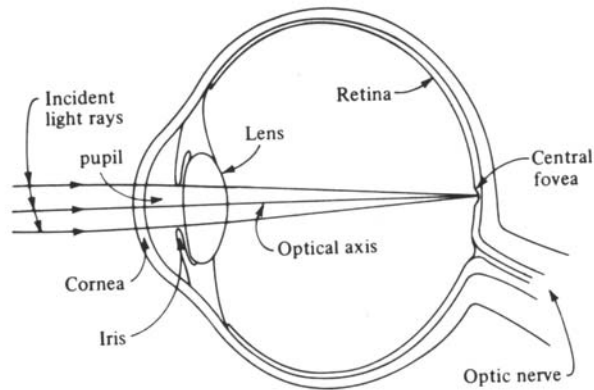
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L'occhio umano



Its behavior is very similar to that of a camera

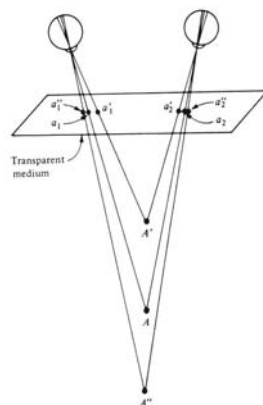
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Stereo-disparity



Points further away are projected on points closer to the image center.

Vergence and focusing are strictly connected.

Also monocular cues: shading, apparent size,

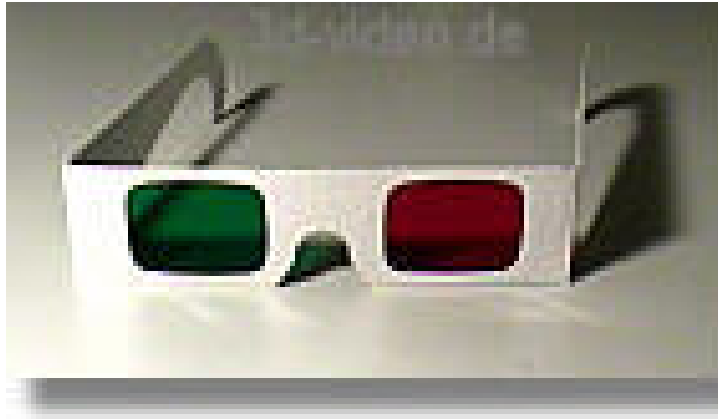
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Passive stereo



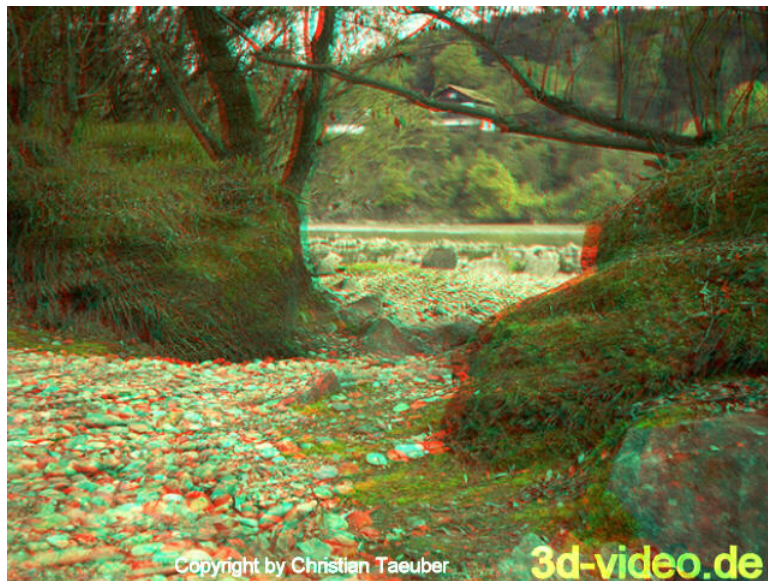
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Stereo image for passive stereo



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Stereogramma con parallasse



Brevetto del 1903

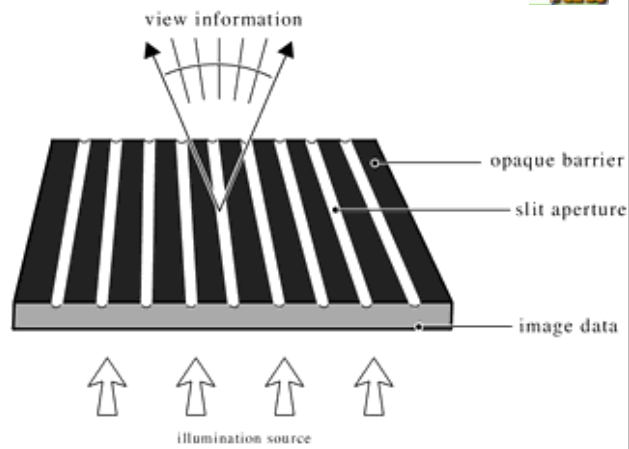


Immagine suddivisa in strisce verticali.

Coppie di strisce, associate alla parallasse orizzontale, sono posizionate in funzione dell'angolo.

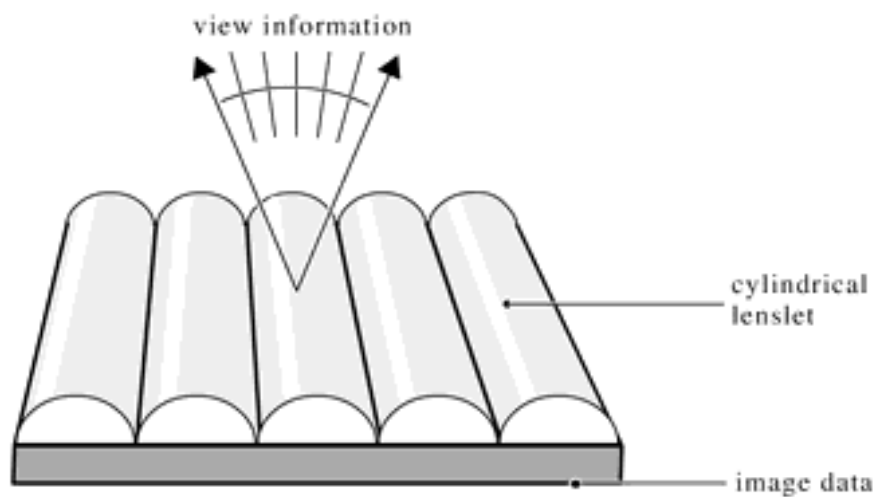
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Display Autostereoscopici



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Output devices (eye-glasses)



Semi-immersive: Eye-glasses (video accuracy, but user is not allowed to move, lateral vision is permitted, which limits virtual realism).



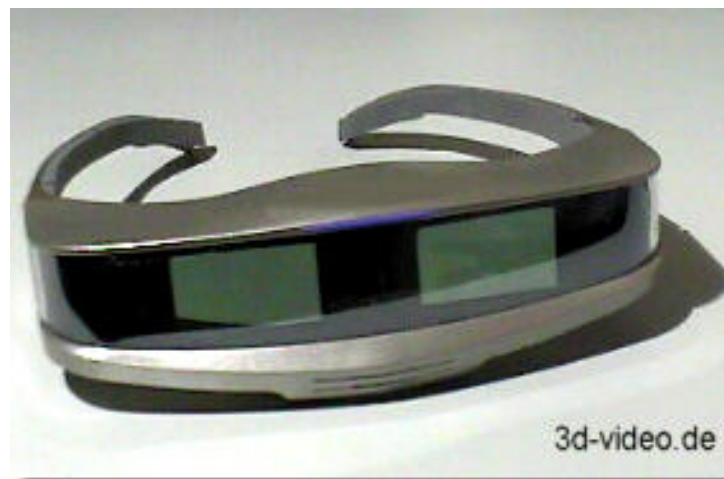
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I-glasses (games)



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HMD (n-vision)



Up to 1280 x 1024, 180Hz.
Time multiplexing.

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Output devices (BOOM HMD)



Up to 1280 x 1024 pixels / eye
CRT Technology
Head tracking is integrated.



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CAVE



Room 2.5m x 2.5m
with Virtual images
(stereoscopic) projected
onto its walls.

More people and
Complete immersivity.



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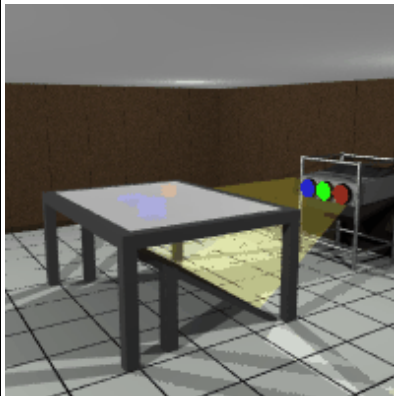
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Responsive work-bench (Strauss et al., 1995)



Virtual 3D objects are positioned on a working table. They are created projecting the stereo images over the table surface.



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Large screen displays



Workwall



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Physiological problems



- SIMM and VR sickness limit the exposure time.
- Size and distances misperception.
- Limited range in extrapersonal space.

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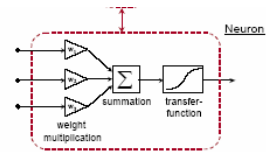
Other output devices



Audio – Stereo, sound spatialization.

Olfactory – Virtual nose

Type	Sensitive material	Detection principle
semiconducting metal oxides (M.O.S., Taguchi)	doped semiconducting metal oxides (SnO ₂ , GaO)	resistance change
quartz crystal microbalance, QMB surface acoustic wave, SAW	organic or inorganic layers (gas chromatography)	frequency change due to mass change
conducting polymers	modified conducting polymers	resistance change
catalytic field-effect sensors (MOSFET)	catalytic metals	work function change
pellistor	catalysts	temperature change due to chemical reactions
fluorescence sensors	organic dyes	light intensity changes
electrochemical cells	solid or liquid electrolytes	current or voltage change
infra red sensors	-	IR absorption



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Stimolatori tattili



Cyber touch:

- 6 vibratori, uno per dito più 1 sul palmo
- Frequenza di vibrazione: 0-125 Hz.
- Ampiezza di vibrazione: 1.2 N @ 125 Hz (max).



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Wearable devices - Orologi



Computer palmare



Wrist-net
N3




Xelibri – Orologio/telefonino
(come digitare un numero?)



“Paparazzi”

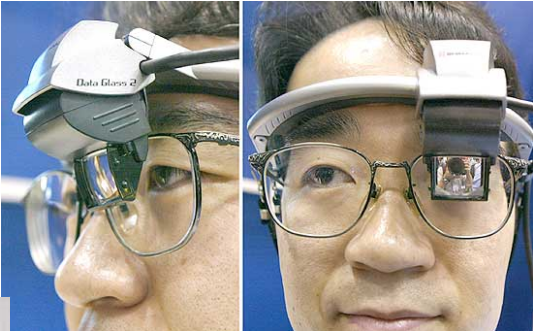
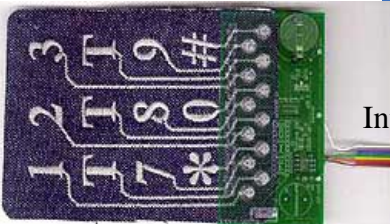
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Wearable devices – input / output



HMD – 320x240 VGA

Characteristics: mobile, context sensitive, augmented reality.

Interfaccia su stoffa.

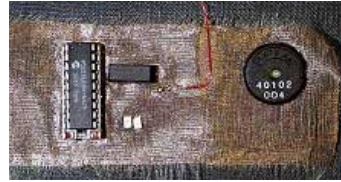
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Wearable devices – Da indossare



E-textile



Circuito stampato su stoffa



Ciondolo
contenente
dati
personali



Siemens
penna-telefono

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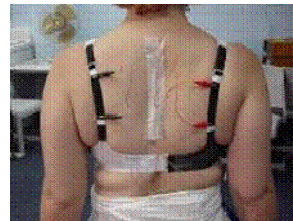
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Wearable devices - IV



Electronical cloths - Sony



Smart cloths

MIT Media lab and industrial style.

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Wearable devices – Micro-sensors



MEMS devices

Typically a MEMS accelerometer consists of interlocking fingers that are alternately moving and fixed. Acceleration is sensed by measuring the capacitance of the structure, which varies in proportion to changes in acceleration.

The elements can be arranged like combs to make a linear accelerometer, as is the type used in airbags, or like the spokes of a wheel to make a rotational accelerometer.

Prototype3

Robotics – fourth generation



<http://world.honda.com/ASIMO/P3/>
Investimento di 10 anni e 100 milioni di dollari.



Qrio - Sony



ERS7

Leonardo - MIT

Visione
Movimento
Coordinazione, flotta di robot (Wifi 802.11b).





Sommario



- Introduzione
- Sistemi di Input
- Generatori di mondi
- Motore di calcolo
- Sistemi di Output
- **Conclusioni**



Applications



- Army
- Medicine
- Industry (inspection, virtual prototyping)
- Chemistry and Physics
- Virtual theaters and theme parks
- Entertainment
- Communication
- Engineering, Ergonomics and Architecture.
- History.



Indossatrice Virtuale



Cf. Politecnico di Losanna

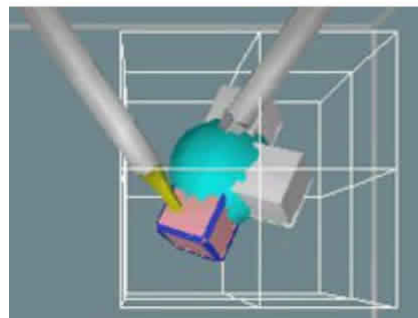
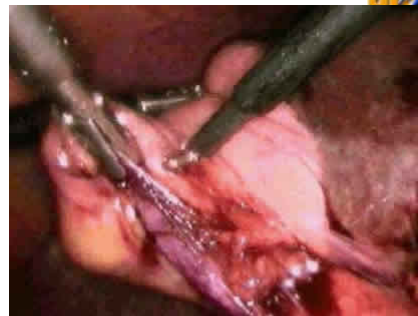
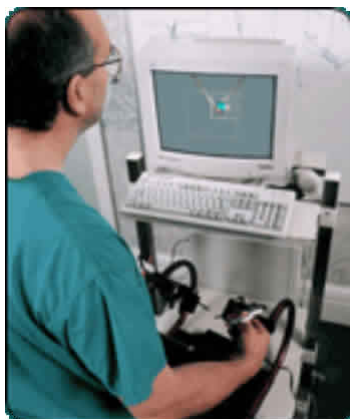
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Simulazione di interventi di chirurgia mininvasiva



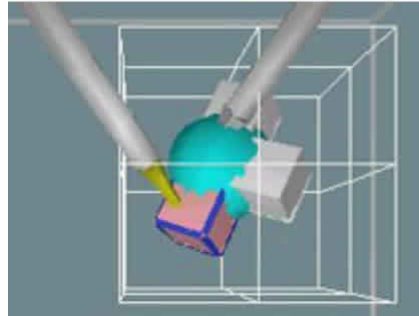
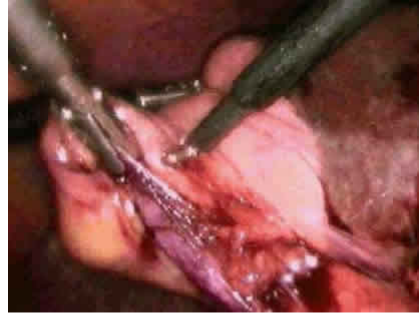
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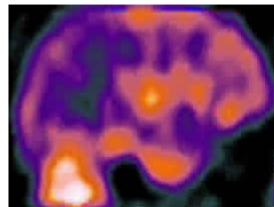
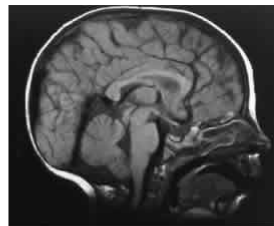
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Fusione di immagini pre e intra operatorie



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Realizzazione di oggetti 3D



Mandibola acrilica realizzata con tecnologia CAD-CAM a partire da scansioni TAC

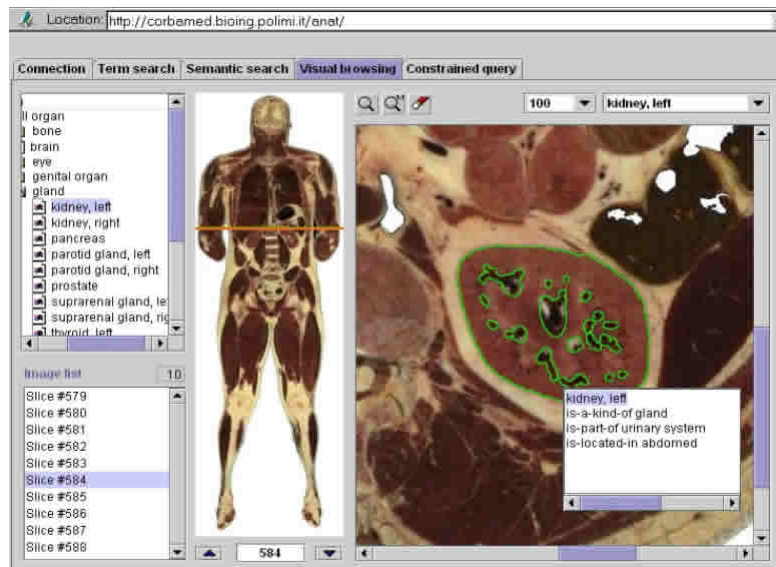
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Anatomia virtuale



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Progettazione: impianti virtuali



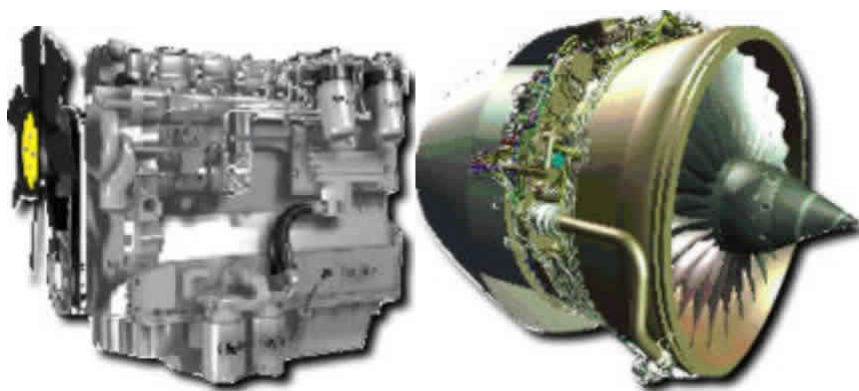
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Progettazione: motori virtuali



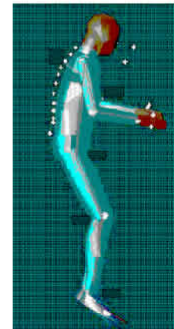
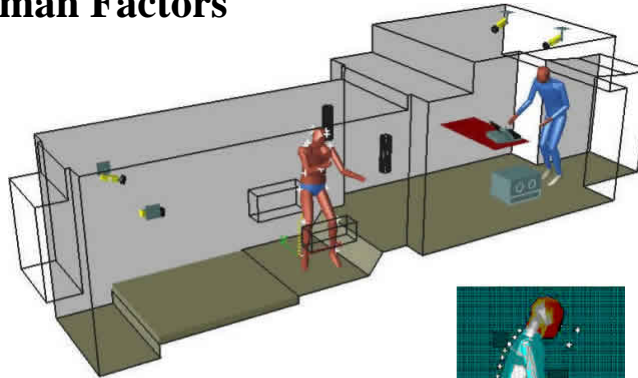
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Human Factors



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La città di Giotto



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La tomba di Nefertari



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