

Surgical Navigation Systems: A short overview

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GE Medical Systems Medtronic SNT

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Navigation

- Essentially, the problem is to find out where you are
- E.g., relating positions on a chart to where your boat is on the ocean (so as to reach port without hitting a reef)

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Simple Surgical Navigation

- Input 3D scan images
- Establish workspace coordinate system
- Register scan coordinate system to workspace
- Track tools and determine location relative to workspace
- Display corresponding positions on images

Image Data Sets Workstation Tracking Device (Localizer) Measure 3D positions

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Preoperative Intraoperative Postoperative

Computer-assisted planning Update Model Update Plan Computer-Assisted Execution Computer-Assisted Assessment

Patient-specific Model Atlas Patient

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“Virtual Fluoroscopy”

- Computer tracks patient, instruments, and x-ray c-arm
- Computer overlays real-time graphics onto x-ray images
- Advantages
 - Reduced x-ray exposure
 - Easy to learn & use
- Limitations
 - 2D projections
 - Relies on accurate tracking

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Example: "Virtual Fluoroscopy"



Source: Sofamor Danek, Inc.

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Example: Pedicle Screw Placement

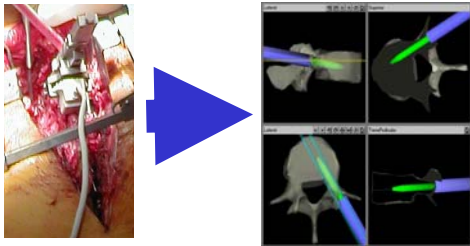


Photo: Orthosoft, Inc.

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Example: Cup Placement in THR

- Navigation system to set angle of cup component in hip replacement
- Potential to reduce dislocations
- Used clinically at Shadyside Hospital



Source: Center for Orthopaedic Research, Shadyside Hospital

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Other Examples



BrainLab, AG

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Other Examples



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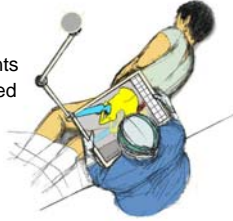
BrainLab, AG

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Evolution: Information-Enhanced Minimally Invasive Surgery

- **“Surgical CAD”**
 - Model anatomical structures
 - Plan “key frames” and geometric relationships
- **“Surgical CAM”**
 - (Re)locate anatomy & instruments
 - Generate real-time and registered visualization
 - Exploit surgeon’s dexterity
- **“Surgical TQM”**
 - Keep log of what was done

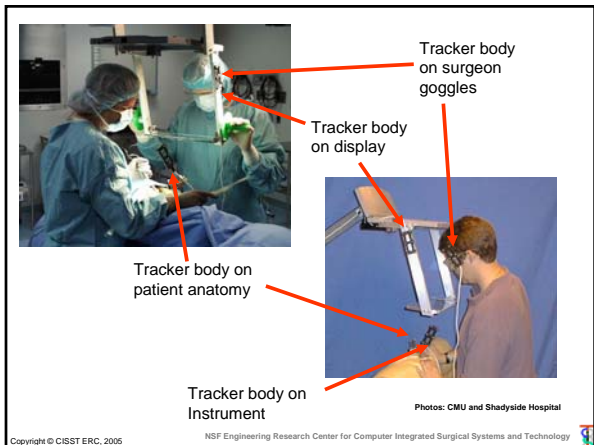


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