Computer Integrated Surgery – Introduction

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Prediction

The impact of aided interventional technology on medical care in the next 30 years will be as great as the impact of CAD/CAM systems and technology on industrial production over the past 30 years.
Mission Statement

Develop basic science, technology, and engineered systems working cooperatively with physicians to significantly change the way interventions and surgical procedures are planned, carried out, monitored, and assessed.
Couple the Information to Action

- Mental computation
- Mental coupling of plan to action
- Hand-eye coordination
Impact of CIS

- Procedures performed “better”
- Availability increased
Computer Integrated Surgery Systems

Preoperative

- Computer-assisted planning
- Patient-specific Model

Intraoperative

- Update Model
- Update Plan
- Computer-Assisted Execution

Postoperative

- Computer-Assisted Assessment
- Atlas

Patient

Laboratory for Percutaneous Surgery – The Perk Lab

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Surgical Assistant Systems

Preoperative

Computer-assisted planning

Patient-specific Model

Intraoperative

Update Model

Update Plan

Computer-Assisted Execution

Postoperative

Computer-Assisted Assessment

Atlas

Patient

Surgical Assistants
Surgical CAD/CAM Systems

Surgical “CAD”

Preoperative
Computer-assisted planning
Patient-specific Model

Tight computer link during surgery

Surgical “CAM”

Update Model
Update Plan
Computer-Assisted Execution

Organized By Computer

Surgical “TQM”

Preoperative
Intraoperative
Postoperative
Atlas

Patient
Surgical "CAM"

"CAD"
"TQM"
Computer Integrated Surgery
Fundamental research barriers

Modeling & Analysis
- Segmentation
- Reconstruction
- Data fusion
- Treatment planning

Physical Interfaces
- Imaging
- Tracking & sensing
- Robotics
- Augmented reality

Systems Integration
- System design & architecture
- Performance analysis
- Clinical applications
Imaging
Segmentation
Data fusion
Treatment planning

3D image/volume fusion combined with arc design
volume and isodose surface overlaid on 3D image/volume fusion
Robots – for prostate cancer implants
Robots – for prostate cancer biopsy
Robots – for total hip/knee replacement
Robot – for laparoscopic telesurgery
Robot – Steady Hand microsurgery
Augmented reality
Clinical applications
How can we get there?

Strong and committed teams
- Surgeons
- Engineers
- Industry

Focus on systems that address important needs

Rapid iteration with measurable goals

Have fun!
The real bottom line: patient care

• Provide new capabilities that **transcend human limitations** in surgery
• Increase **consistency and quality** of surgical treatments
• Promote **better outcomes** and more **cost-effective** processes in surgical practice
Thank you!

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