Simulation Sandbox for the daVinci System
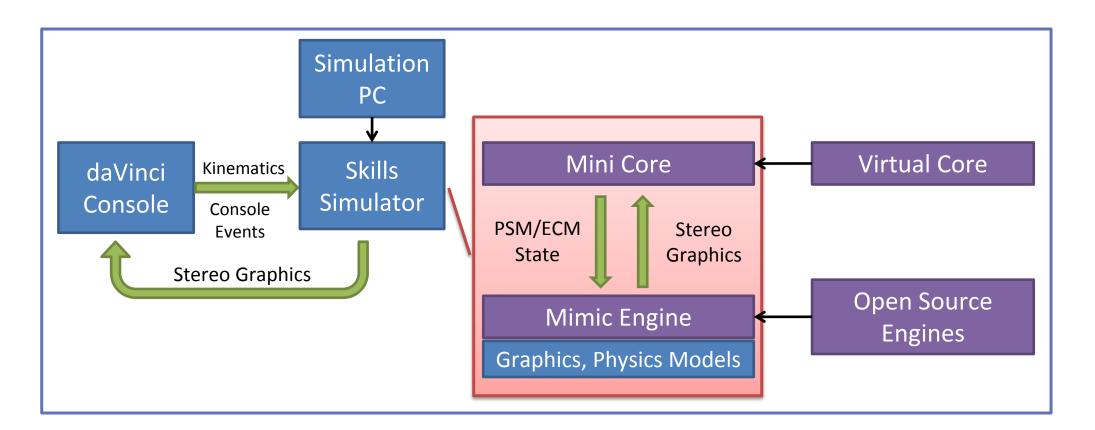
Computer Integrated Surgery II (Spring 2013)

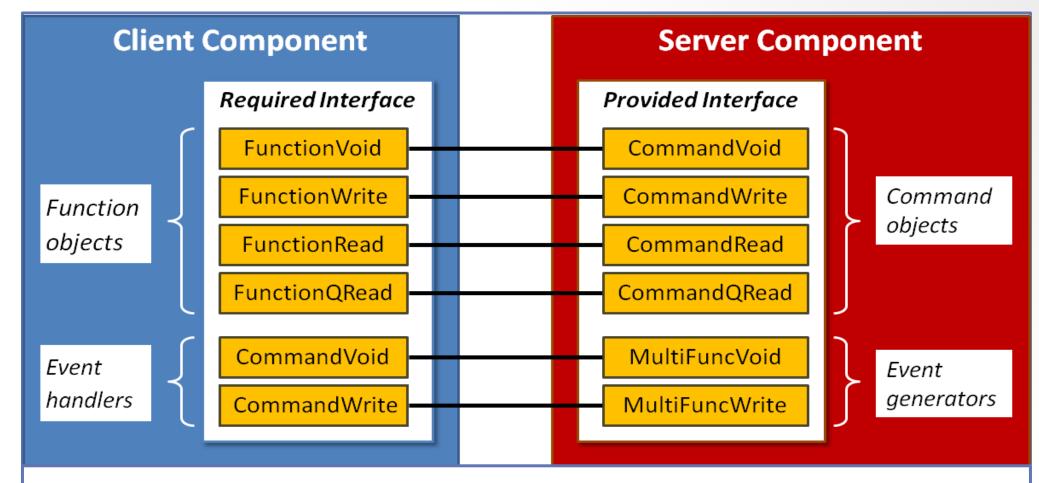## Anand Malpani

under the guidance of Anton Deguet, Prof. R. H. Taylor, Simon DiMaio, Ashwinram Suresh

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Introduction

- Development of a **Simulation Sandbox** based on Open-source software packages for robotic surgery using the *Intuitive Surgical Inc.*'s *daVinci*® patient cart and *EndoWrist* instruments

- Demonstrate use of such a sandbox using the *daVinci System*'s surgeon console

Motivation & Significance

- Currently, simulation (*Mimic Simulation*) on the *daVinci Skills Simulator* is a **black box** with no access to the models and the rendering pipeline

- We aim to create a sandbox application containing a *library* of pre-existing object models and **open** access

- Developers can **add new models** to the library as well as implement new simulations using the library

- Surgeons can do **procedural planning** using patient specific anatomical models before the actual case

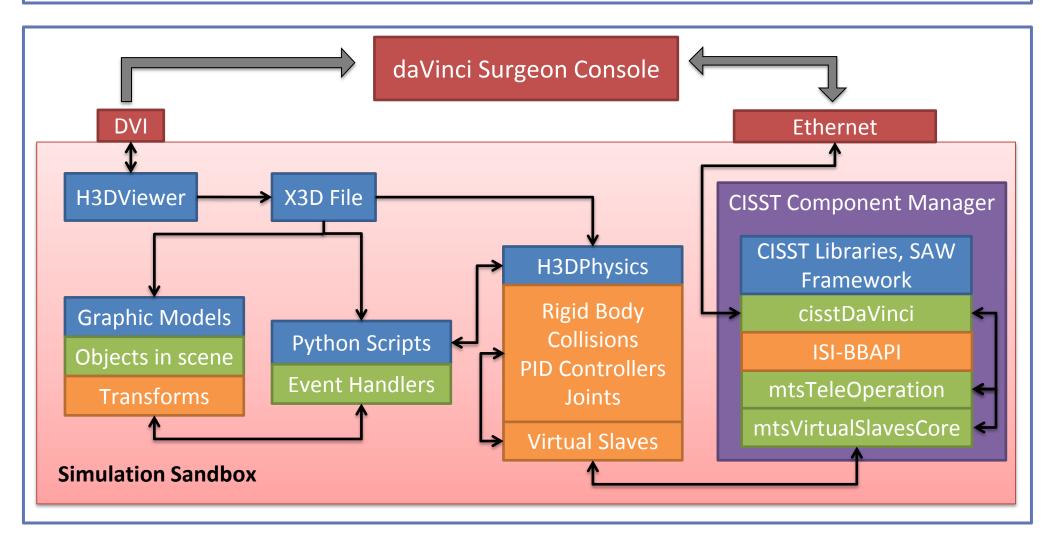- Sandbox can be a **prototyping platform** for testing new procedures, instruments, user interfaces
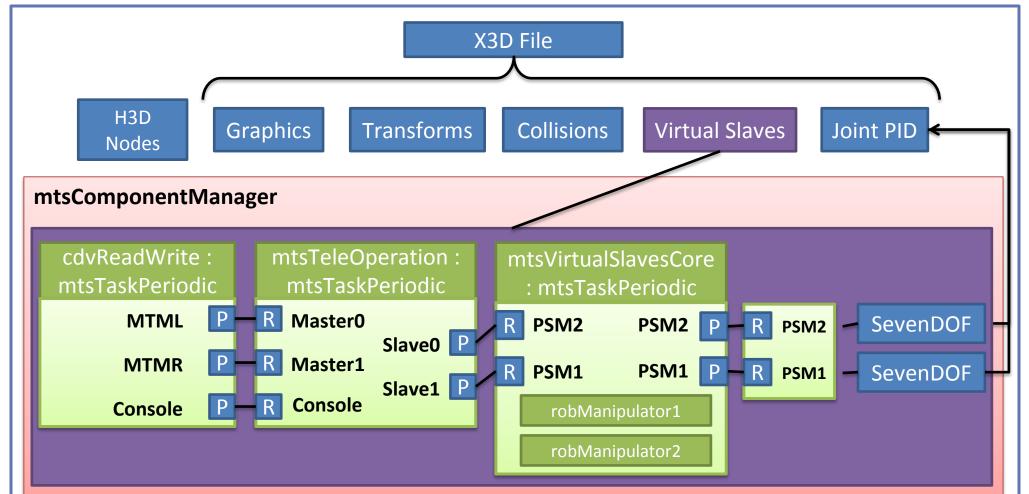
Software Dependencies

- **ISI-BBAPI**[1]

  Provides read/write access to *daVinci* master console

- **CISST-SAW**[2,3]

  - Framework for *computer-assisted* interventions

  - Interfaces with computer integrated surgical devices

  - Based on a **component-interface** model

  - Developed *mtsTeleoperation*, *mtsVirtualSlavesCore* components that pass slave kinematics to H3D nodes

  - extended the *cisstDaVinci* component (ISI-BBAPI)

- **H3DAPI, H3DPhysics**

  - Scene-graph API for graphics, haptics rendering

  - Wrapper for physics engines like *Bullet*, *ODE*

  - Interfaced using **X3D**, Python and/or C++

  - *Fields* – basic building blocks for data passing

  - *Nodes* – containers for a group of *fields*

  - Developed the *VirtualSlaves* node for connecting to the CISST components

CISST Component-Interfaces Framework[2]

Current Status

- Functioning teleoperation unit to communicate between a master and the virtual slaves

- PID control for simulated tools not functioning

- Teleoperation supports clutching and follow mode

- Library contains instrument model along with simple objects like rings, cubes, pegs (courtesy Ashwin, ISI)

Future Work

- Functioning of the entire system as shown above
- Camera control implementation using virtual fixture
- Add complex object models to library

References

[1] DiMaio et. al. The daVinci Research Interface, SACAI 2008

[2] Deguet et. al. The cisst libraries for computer assisted interventions, SACAI 2008

[3] Vagvolgyi et. al. The Surgical Assistant Workstation, SACAI 2008

Acknowledgments