da Vinci Research Kit

Anton Deguet
Peter Kazanzides

Laboratory for Computational Sensing and Robotics
Johns Hopkins University
The real *da Vinci*

- **Who:** Intuitive Surgical
- **What:**
  - Tele operated robotic system for minimally invasive surgery
    - 2 master arms with force feedback
    - 3 Patient side manipulator with interchangeable tools
    - 1 Endoscope manipulator (4 DOFs)
    - 4 Passive arms on the patient side
  - Commercial product, FDA approved
  - Mostly closed system!
- **When:**
  - Multiple iterations since mid 90s: Classic, S, Si, Xi, …
  - *First generation commercialized in 1999 and is being retired*
The dVRK, da Vinci Research Kit

• What:
  • Arms from retired *da Vinci* Classic gifted by ISI or local hospital, eBay…
  • Not commercial: NSF, NIH and other grants
  • **NOT FDA approved**, not for patients, *research ONLY!*
  • Started about 4 years ago

• **What’s new?**
  • Custom controllers developed at JHU and WPI
  • Software stack running on a Linux PC:
    from IO to applications
  • All Open Source and on github:
    board design, firmware, software, models

• Who:
  • Johns Hopkins University (JHU)
  • Worcester Polytechnic Institute (WPI)
  • Intuitive Surgical (ISI)
  • Community (32 systems on 28 sites in the world)
Where is the dVRK? – over 32 systems at 28 sites

- The Johns Hopkins University
- Worcester Polytechnic Institute
- Stanford University
- University of British Columbia
- Vanderbilt University
- UC Berkeley
- Carnegie Mellon University
- Toronto Sick Kids
- SSISA, Pisa
- Western University
- Seoul National University
- Öhada University
- Wayne State University
- Università di Verona
- Imperial College London
- University College London
- Children’s National Medical Center
- Cassa Western Reserve University
- Università degli Studi di Napoli
- Bar-Ilan University
- University of Illinois
- Politecnico di Milano
- Chinese University of Hong Kong
- University of Leeds
- University of Texas, Dallas
- University of Innsbruck
- Reutlingen University
- Clemson University
How we use ROS

• Python catkin build tools!
• ROS topics for everything we can
• Python and Matlab wrappers for students (hides topics and messages)
• rosbag for debugging, user studies
• rviz, gazebo models (thanks to WPI)
• Stereo video pipeline: frame grabbers (gscam!), calibration, 3D display with rviz and augmented reality
Why ROSCon?

• Meet the (medical) robotics community to share software and hardware information

• Standardized APIs for joint/cartesian motions, force feedback, masters, slaves…
  • Raven, UR5, UR3, Kuka, custom robots
  • Novint Falcon, 3D Touch/Sensable Omni, ForceDimension Sigma/Omega, hand trackers

• Side events:
  • Raven/dVRK community user group on Saturday
  • IROS’17 Workshop on Sunday, “Shared Platforms for Medical Robotics Research”