

da Vinci Research Kit-S

Creating next-generation open-source
research platform

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SMARTS

Sensing, Manipulation, and Real-Time Systems



What is the *da Vinci* Research Kit?



- ISI has donated *da Vinci Standard* systems that are retired from clinical use to universities for research since 2012
- Replace control system and software with open-source framework



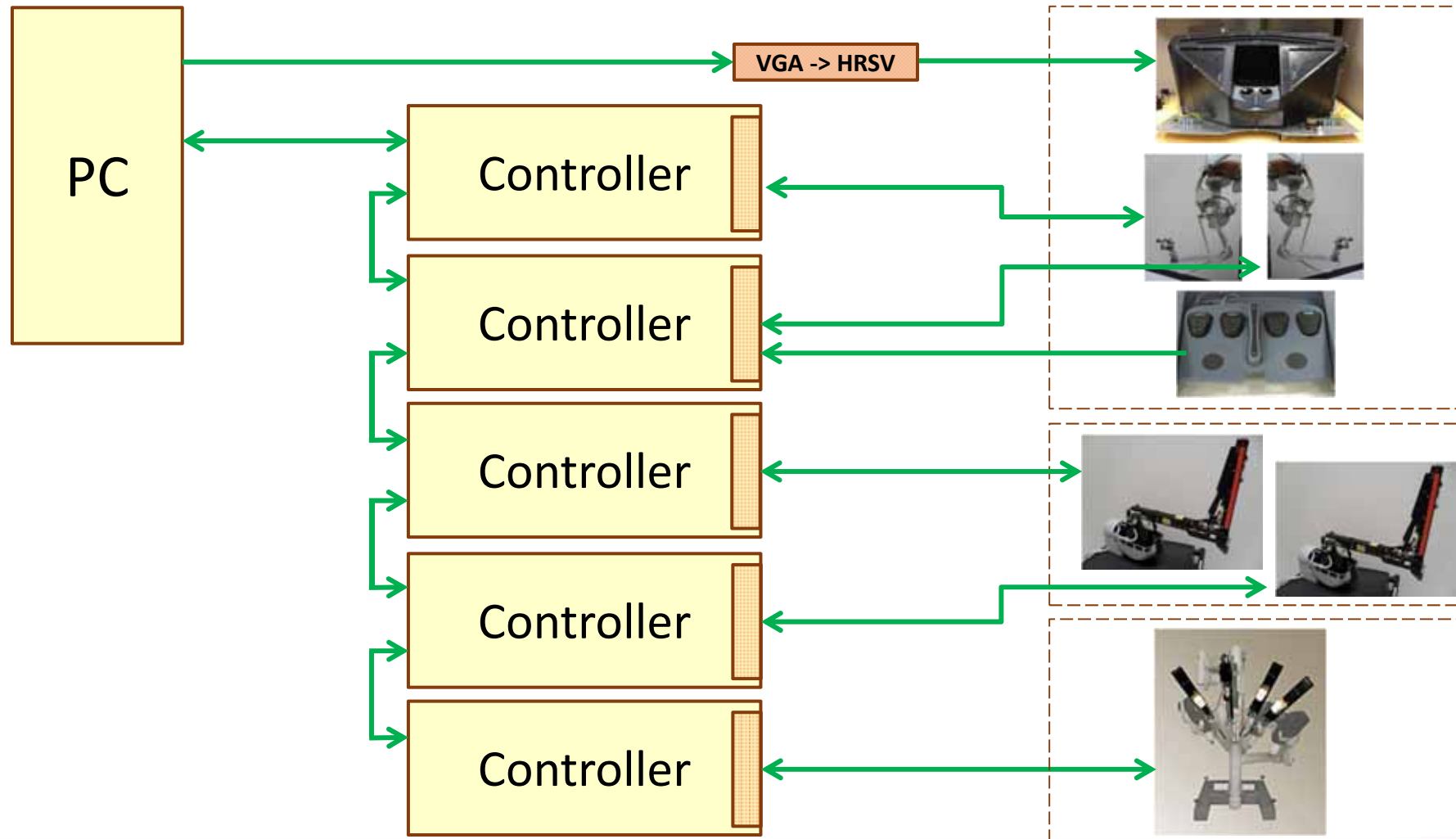
Images of the dVRK set up from JHU and CMU group



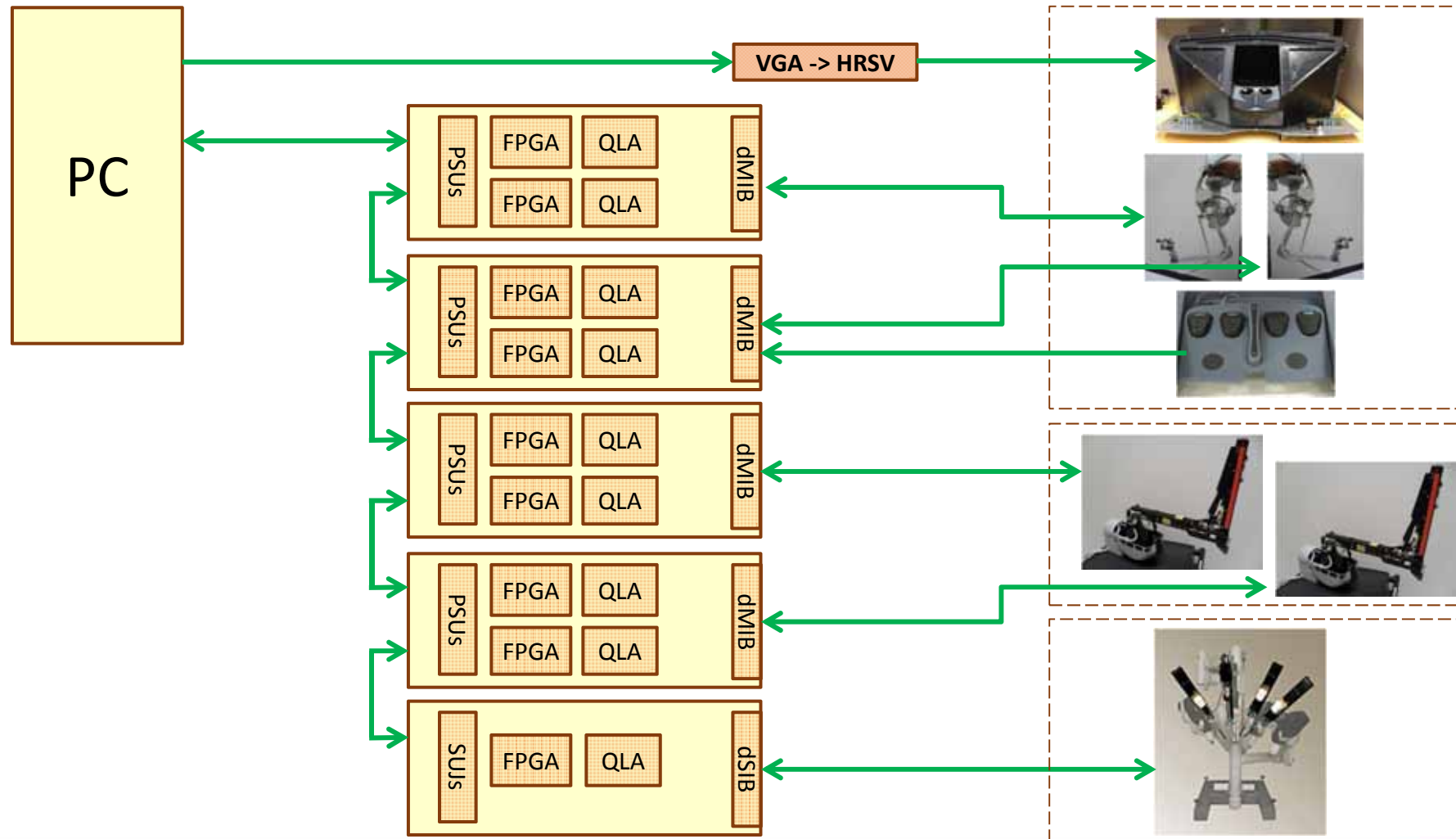
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System Overview



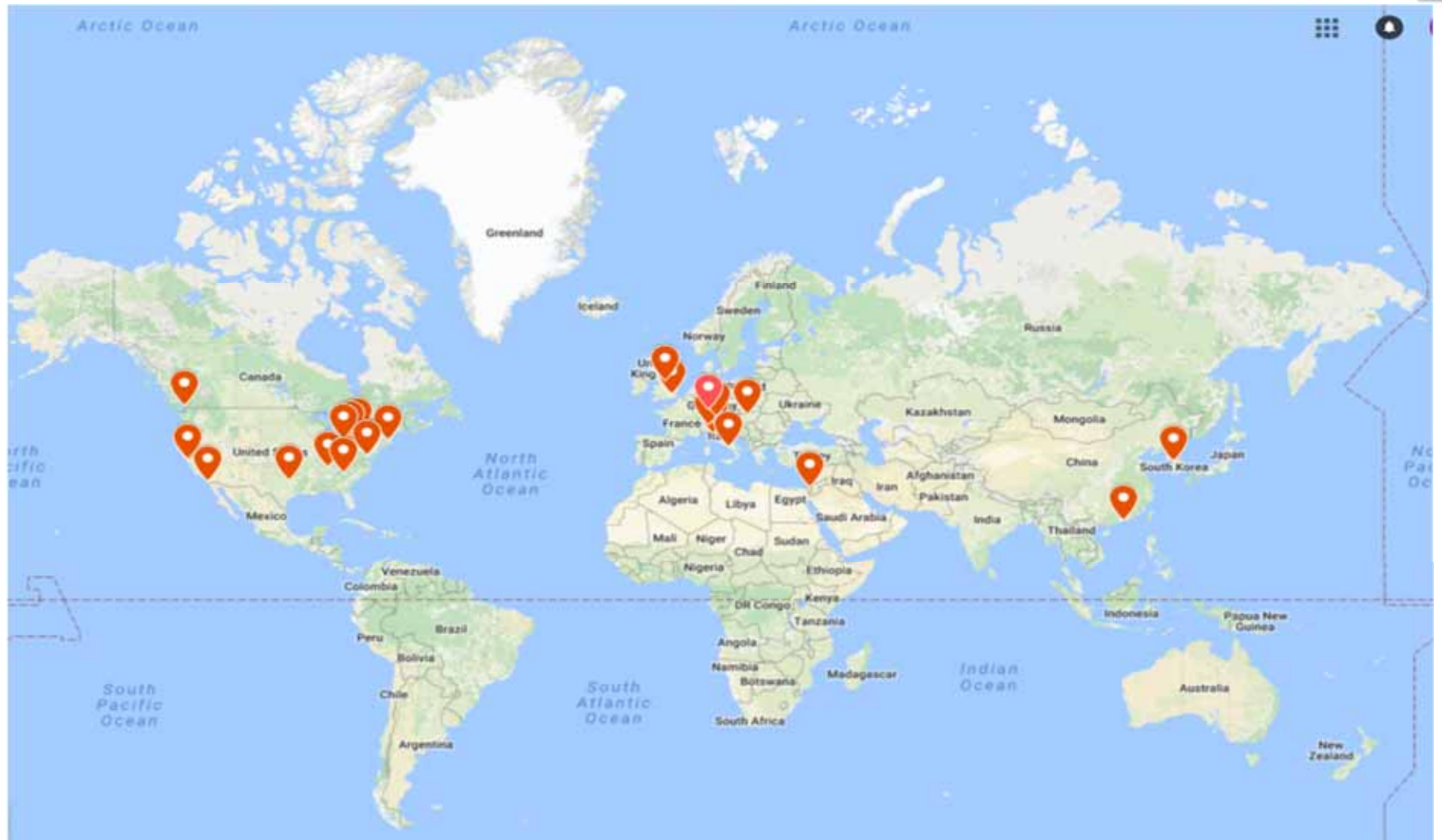
System Overview



Where is the dVRK? – over 32 systems at 28 sites



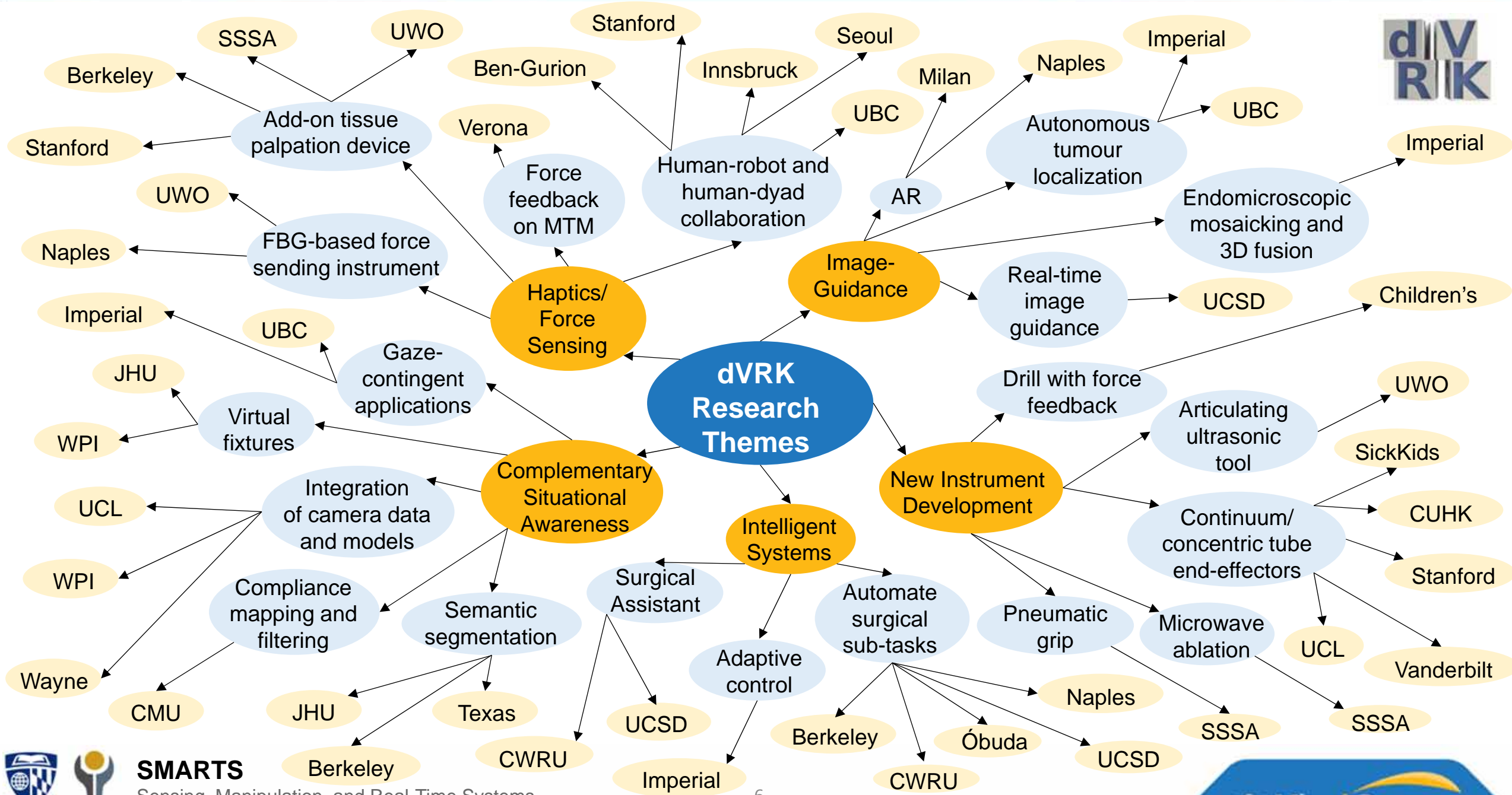
- 📍 The Johns Hopkins University
- 📍 Worcester Polytechnic Institute
- 📍 Stanford University
- 📍 University of British Columbia
- 📍 Vanderbilt University
- 📍 UC Berkeley
- 📍 Carnegie Mellon University
- 📍 Toronto Sick Kids
- 📍 SSSA, Pisa
- 📍 Western University
- 📍 Seoul National University
- 📍 Óbuda University
- 📍 Wayne State University
- 📍 Università di Verona
- 📍 Imperial College London
- 📍 University College London
- 📍 Children's National Medical Center
- 📍 Case Western Reserve University
- 📍 Università degli Studi di Napoli
- 📍 Ben-Gurion University
- 📍 University of San Diego
- 📍 Politecnico di Milano
- 📍 Chinese University of Hong Kong
- 📍 University of Leeds
- 📍 University of Texas, Dallas
- 📍 University of Innsbruck
- 📍 Reutlingen University
- 📍 Clemson University



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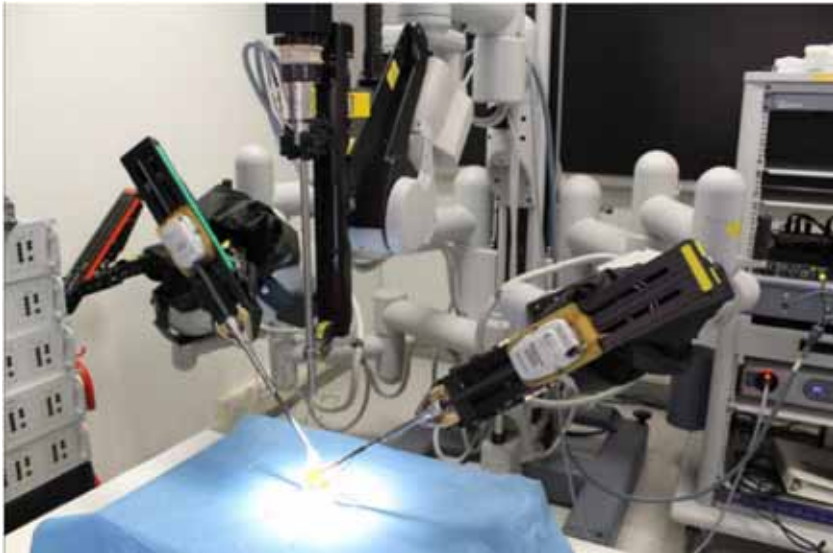




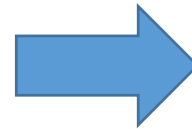
Next generation dVRK



- Adapt the *da Vinci S* arms to work with the existing dVRK infrastructure
- Expect to retire many *S/Si* PSM due to the *da Vinci X*



Current generation dVRK set up at Politecnico di Milano

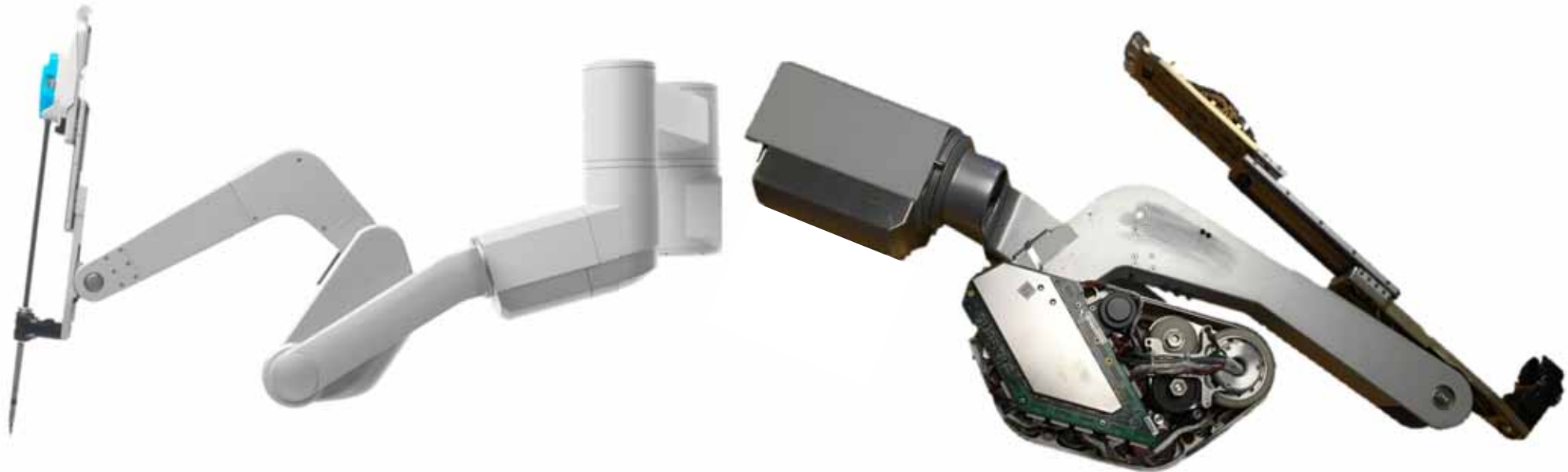


da Vinci S © Intuitive Surgical Inc.

Challenges of the dVRK-S



- First generation had no on-arm processing
- Second generation does, so what can stay on the board?
- Goal: Provide low-level open-source access of the first generation while protecting ISI's IP



da Vinci S PSM with and without plastic cover



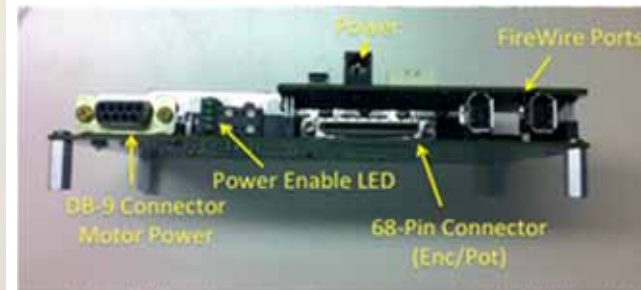
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Keep the hardware, but change the firmware



- Simplified communication protocol to transmit serialized sensor data
- Do some on-arm processing so new algorithms can be incorporated
 - These are open-source, but keep ISI's hardware interface firmware closed
 - Distribute compiled firmware images only
- Serialize the data and drive motors from the dVRK QLA



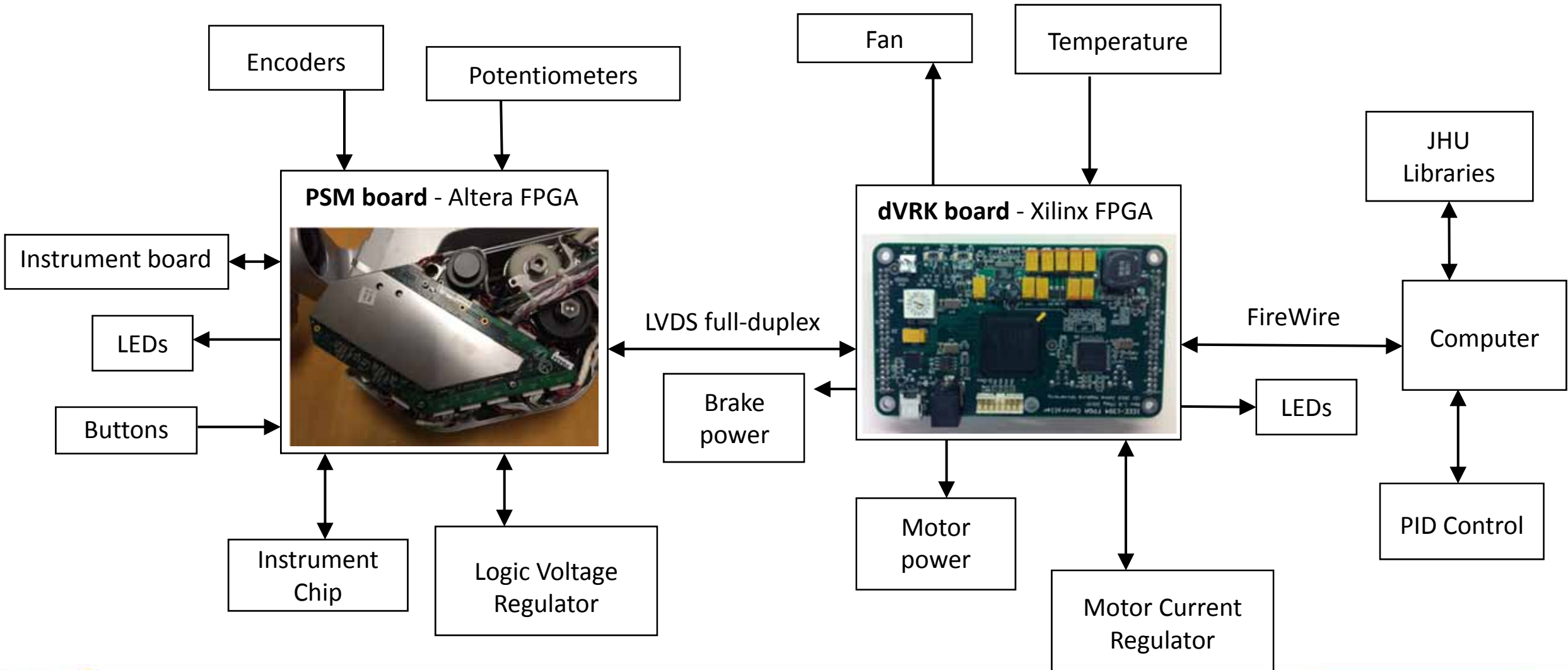
4/5 Pin-header replaces the 68-Pin connector to connect to the PSM



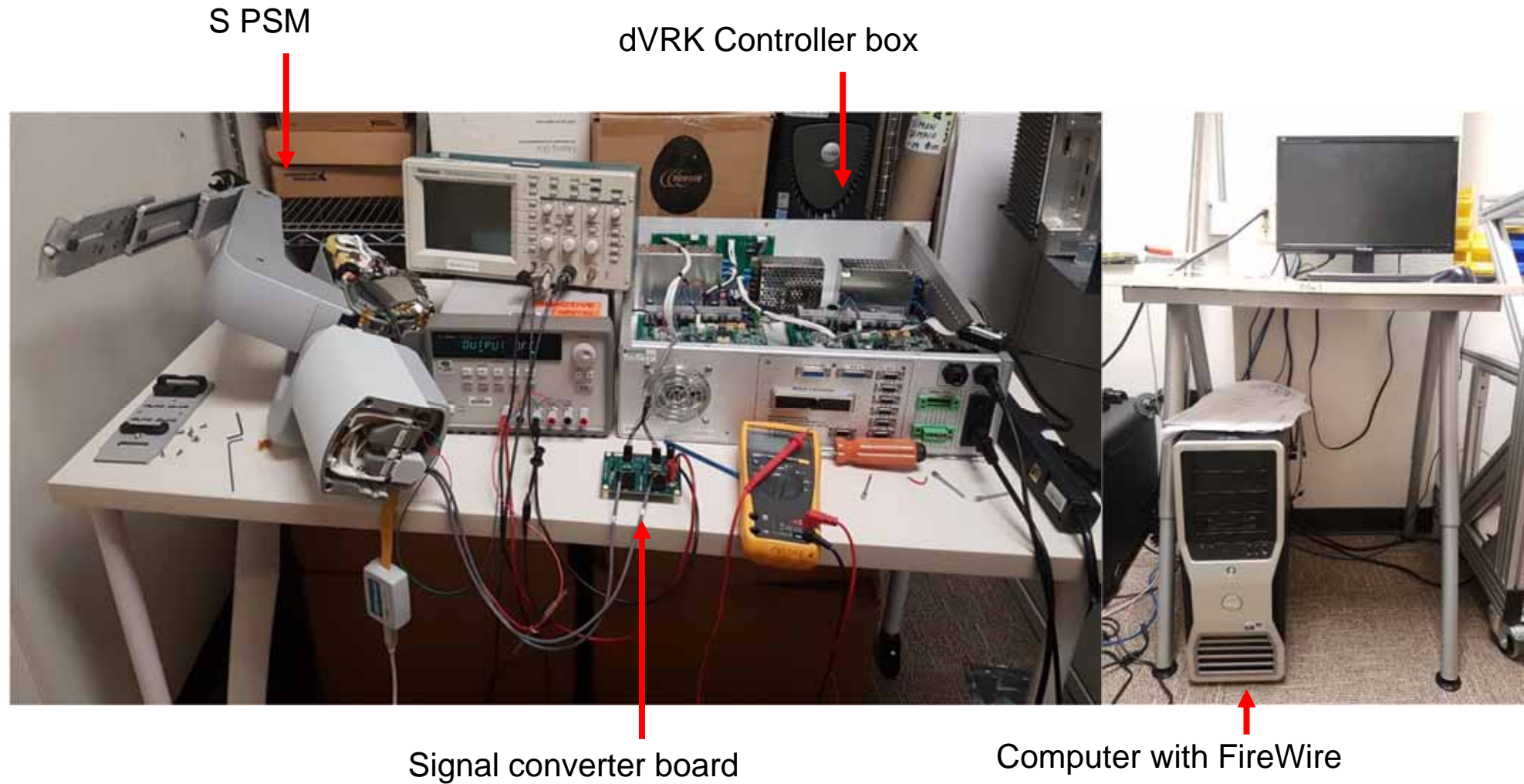
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Modules of the dVRK-S



dVRK-S development



Current state of the
dVRK-S

Surgical instrument interface



- Extract instrument information from the instrument chip without decoding the sensitive information
- Instrument chip driver's clock is calibrated at power-up
- This calibration is fragile - suspect temperature effects
- Currently seems robust to normal usage



Discussion

