Team DRC-Hubo

Kickoff Meeting, Oct 23-25, 2012, Arlington VA

Presented by Paul Oh (Team Lead, Drexel University)

Drexel University · University of Delaware · The Ohio State University · KAIST · Georgia Tech · Swarthmore · WPI · Indiana University · Purdue University · Columbia University

Aligning our "Why" with the DRC Vision…

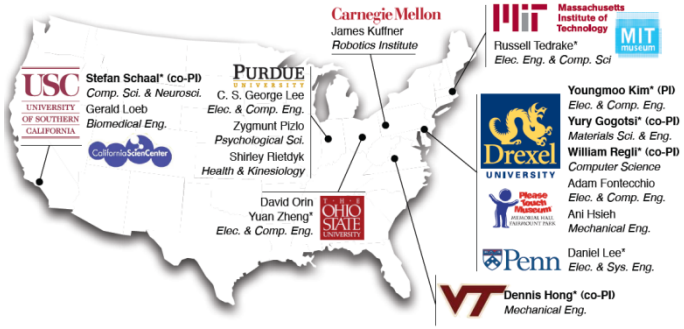
Background:

Korea: Leadership in Humanoid Design

US: Leadership in AI and IT

http://dasl.mem.drexel.edu/pire/

2007-2012 Less than 3% of US S&T students are prepared for international design teams. Use humanoids to motivate, inspire and train global and systems engineering skills

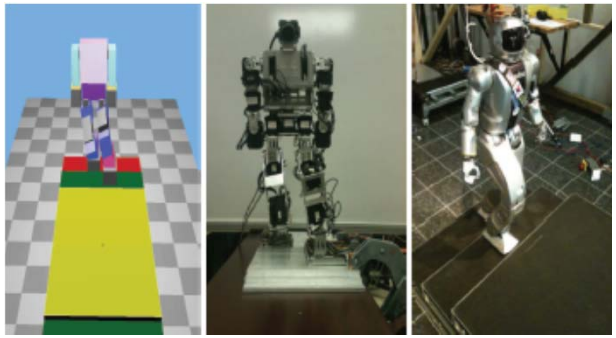


Major Research Infrastructure (MRI-R2)

2010-2013 Humanoid research is eclectic, ad-hoc and difficult to verify. Acquire 6 Hubo+ to benchmark results, formulate practice, and establish foundational theory

Conviction: *The "brains" must be developed in concert with the "body"; realizing the DRC vision must attend to both hardware and underlying motion planning software*

Why Hubo?



From Unique Tools…

(1) Virtual-Hubo
(2) Mini-Hubo
(3) Online-Hubo

To Public Realizations…
http://www.youtube.com/watch?v=OA_u5Q3D57o&feature=g-all-u

DOF	40
Height	130 cm
Mass	41 kg
Battery Run-time	1 hour
Battery Type	17-cell LIPO (8 A-hr)
Computing	Two x86 SBC
Running Speed	3.6 km/hr
Carrying capacity	10 kg

Sensors: IMU (6-axis), Force/Torque (each foot and each write), monocular camera, stereo microphone

- Hubo: Form-and-function "top of class"
- Open Architecture
- 20+ person-years US-Korea Collaboration
- Proven 3-tier infrastructure for T&E and V&V
- 10-year old boy size: suitable for DRC events

- 7-Hubos: parallel development
- Program-Modify-Perfect vs. Design-Build-Hack
- Regional distribution of Hubos
- RP – T&E and V&V Cycle
- OpenHubo drive DRC-Hubo retrofits

Hubo: Latest Capabilities Underscore Promise for DRC

Videos of capabilities: http://dasl.mem.drexel.edu/DRC

DRC-Hubo: Notional


Event 1: Vehicle

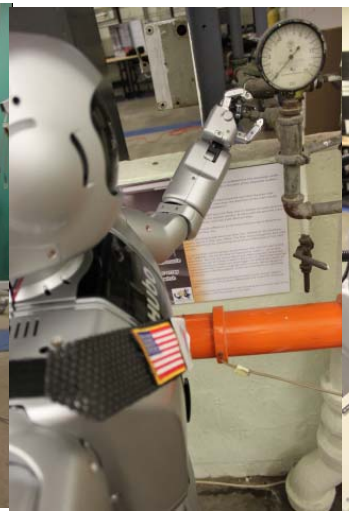

Event 2: Terrain

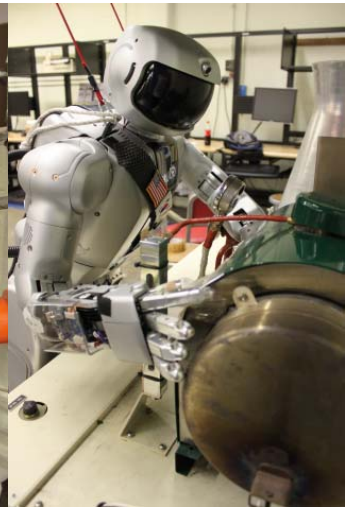

Event 3: Debris


Event 4: Door


Event 5: Ladder

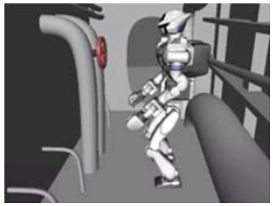

Event 6: Wall Break

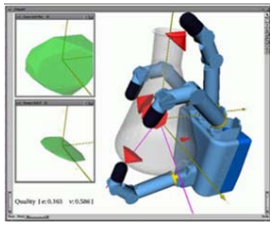

Event 7: Valve

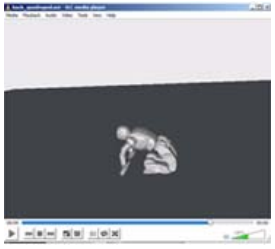

Event 8: Pump

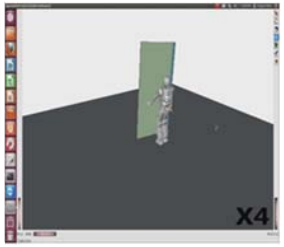
Dream Team: Domain Experts

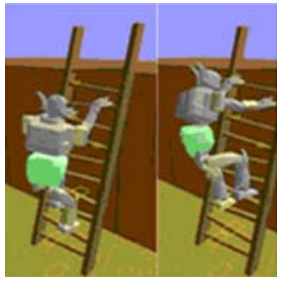
(aka: Ocean's 11 Approach)











Lead PI and Project Management
Engineering: **P. Oh** (Drexel)
Contracts: PiAC Inc. and Drexel

Design
* Modifications
* Construction
* Retrofits

Algorithms
* Rapid Prototyping
* Testing and Evaluation
* Verification and Validation

Korean Partner

Hardware
Support & Modifications
KAIST/Rainbow LLC: **J.H. Oh**
(Hubo Lab)

# of Hubos for Region: 4

Northeast Partner

Event 1 – Ingress/Drive/Egress
Drexel: **P. Oh**
UD: **C. Rasmussen**, Poulakakis, Tanner

Event 4 – Open Door
Swarthmore: **M. Zucker**

Event 7 - Valve
WPI: **D. Berenson**, Chernova, Lindeman

Event 8 – Pump Removal/Replace
Columbia: **P. Allen**

# of Hubos for Region: 2

Midwest Partner

Event 2 – Walk Through Rubble
OSU: **Y. Zheng**, Orin

Event 5 - Ladder
Purdue – IU: **G. Lee**, **K. Hauser**

# of Hubos for Region: 1

South Partner

Event 3 – Debris Removal
Event 6 – Wall Break-through
Georgia Tech: **M. Stilman**, Egerstedt, Bobick

P. Oh
Drexel

J.H. Oh
KAIST

C. Rasmussen
U Delaware

M. Stilman
Georgia Tech

M. Zucker
Swarthmore

Y. Zheng
Ohio State

G. Lee
Purdue

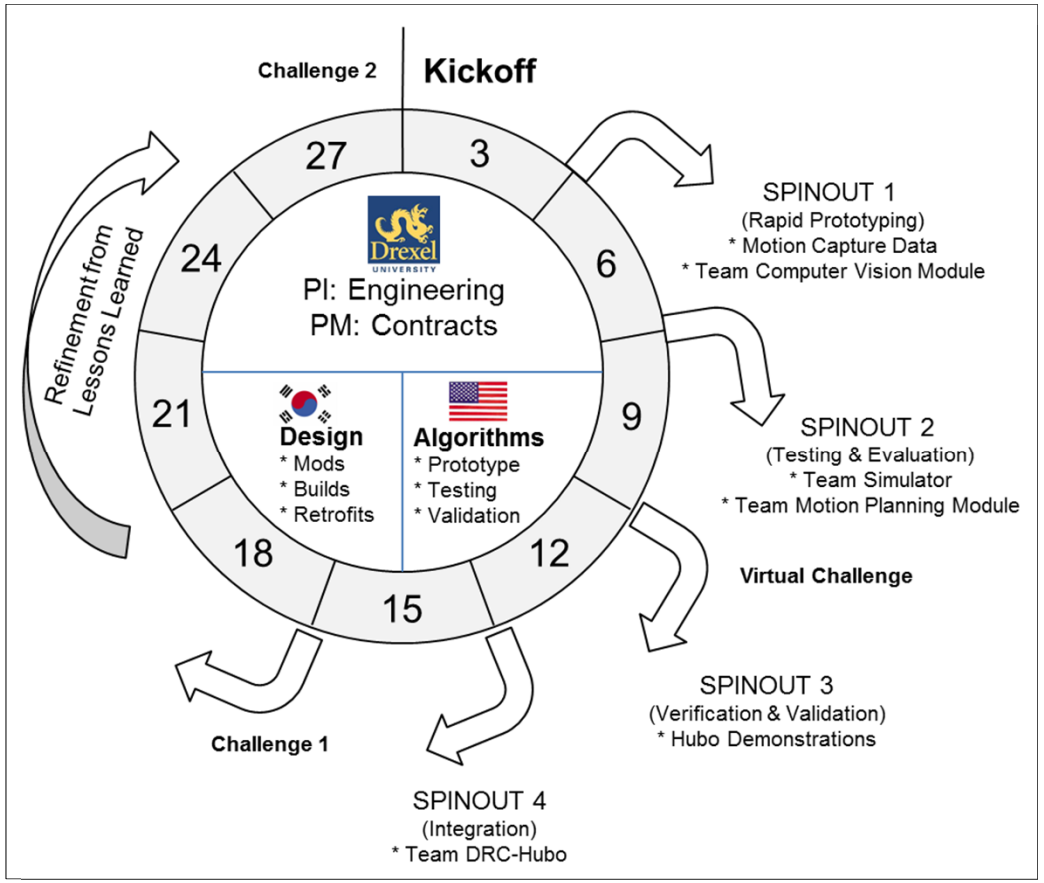
K. Hauser
Indiana U

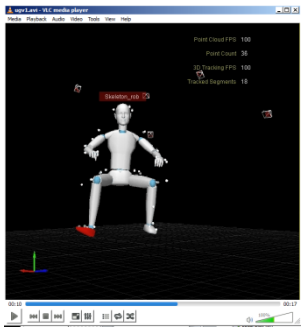
D. Berenson
WPI

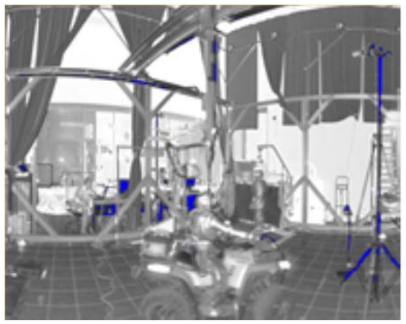
P. Allen
Columbia

Team DRC-Hubo
200+ person-years Expertise
in Humanoids

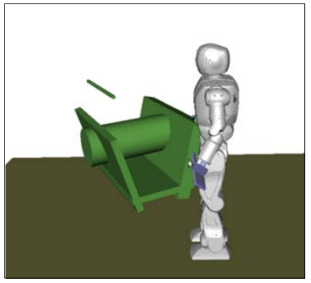
Spiral Development & 3-stage Design Cycle



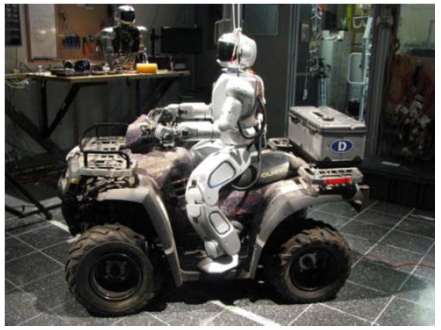




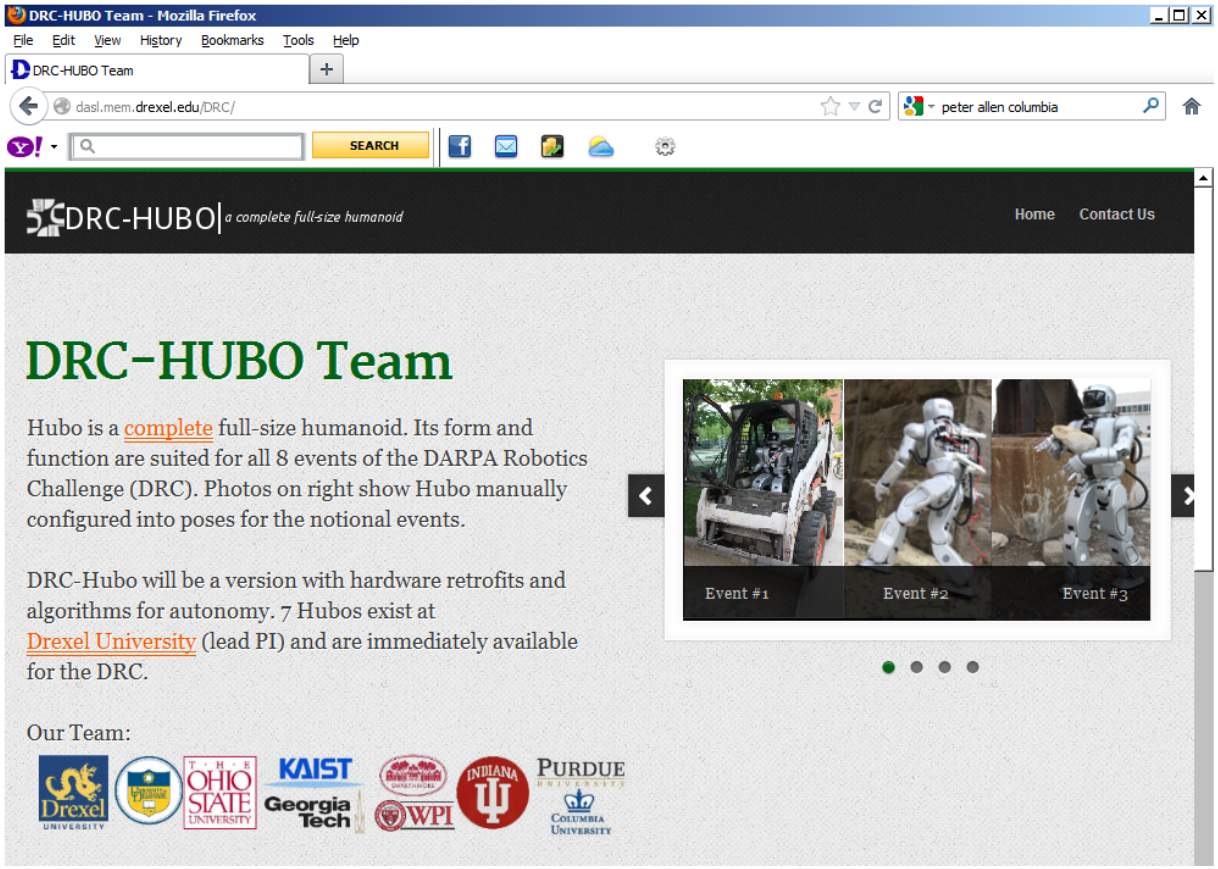
(1) RP: Rapid Prototyping



(2) T&E: OpenHubo



(3) V&V: Hubo+ and DRC-Hubo



Please follow us on: http://dasl.mem.drexel.edu/DRC/

- DRC: Validate training of US students in global design teaming and complex systems engineering (education)
- DRC: Validate “Ocean’s 11” approach and benchmark results (research)
- DRC: Validate design coupling of “brains” and “body”

“The views expressed are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government”