Hubo Upgrade – Small Group Discussion

Goals
- Discuss upgrades in context of past 3-months testing
- Generate questions

Method: Small Group Discussion and Website

- Group 1 Grasping: **Kris** (lead), Dmitry, Peter
  Rm. This room

- Group 2 Leg: **George** (lead), Yuan
  Rm. MEM Dept Main Office

- Group 3 Perception/Control: **Mike** (lead), Matt, and Christopher
  Rm. Down the hall

Grasping-related

1. Will there be sensors on the finger pads? Pressure or shear-force sensors would be nice to sense slip.

2. We were concerned about how positions and torques on the proximal, medial, and distal joints are related via the finger drive system. Can you clarify the comments you made about "20 degrees on the distal joint", and "80% repeatability"?

3. For thin objects that are to be grasped from the sides, will the fingers have the ability to form the proper antipodal grip? Also, will it be able to form a pinch grip?

4. It is possible to get encoders for individual finger links?

5. Will (and when will) CAD models of the hands be provided?

Planning and Perception Related

6. How much extra power will we have, i.e. for sensors, GPU etc.

7. What are the different power taps? And what is the given power available for each? 5V, 12V, 24V

8. Is it possible to make the waist go +-180 deg?

9. At what point will you need to know what sensors we are going to put on the head or other parts of the robot.

10. Also the purpose of +-180 deg movement of the WST is to turn the body around when walking in quadruped mode.

11. How deterministic can we make the position commands to the hand? I.e. Can we make a 1 to 1 mapping between some position value and the overall shape of the fingers?

12. Would it be possible to have motor control boards read (using firmware) force-torque sensor data to have on-board compliance control based on the sensors?

Planning and Perception Related (cont'd)

13. Will we be able to re-wire and utilize four CAN channels to drastically increase bandwidth? Note that Hubo-Ach can seamlessly adapt to this rewiring without any effort.

14. What command modes specifically will be available for the control boards? (I.e. position, current)

15. Can we have a generic conduit (something we can snake wires through) in the arms and legs so we can install arbitrary sensors at the end effectors?

16. Will the IMU be improved to reduce the bias or at least have a consistent bias?

17. Can we be absolutely sure that the new encoders will not slip or lose counts?

18. Can we have "landmarks" on the critical points of the robot to help with calibration? (I.e. Have a unique identifier that allows us to automatically calibrate using vision)

Legs

19. Is it possible to make the foot contact to point contact for rough terrain walking?

20. Longer legs – would they create a problem when entering a vehicle? Would it create more collisions? Is the increased length of the legs optimized for all different tasks?

21. Is the strength of the each leg enough to lift up the whole weight of the robot? How much are the increased joint ranges for leg joints?

22. Can we equip the robot with 6-Axis F/T sensors at least for the feet?

23. How do we control the back EMF in each joint control? The faster the motor is, the more the back EMF will be. Do we have a good control for the back EMF?