AUGUST 31, 2011 PROGRESS MEETING

Upper Limb R2 Engineering Team: Michelle (PI), Sheku, Vince, Daren, Ping, Yagna)
Upper Limb R2 Therapy Team: Joe, Adam, Amy, Jasmine

RERC PEDS – R2 UPPER LIMB ROBOT DEVELOPMENT

Today's Goals

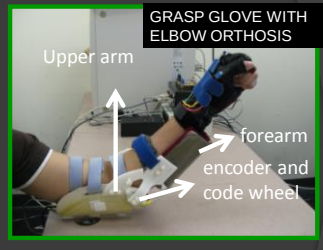
- Two design meeting with Team – in December 2010 and in August of 2011
- Review Project Elements and Year 1 goals
  - Review fMRI/DTI for UL
  - Review of UL Robot System Design Goals and Requirements
  - Overview of UL Robot System Design
    - Chair and Workspace
    - Robot and Orthosis
    - GUI and Controller

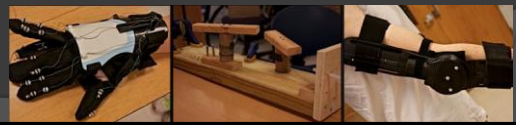
Year 1 Goals

- Modify fMRI equipment for children (senior design working on ideas: Need help to translate to children)
  - Orthosis and Hand Glove
  - Upgrade current orthosis to allow easy of use in fMRI scanner
- Develop biADLER robot and control system
  - Upgrade BiAS System to two actuated robot capable of supporting unilateral or bilateral tasks for desktop activity.
  - Implement ADLER functionality into robots

fMRI/DTI Testing Equipment for Arm and Hand

- We have a prototype of Upper Limb fMRI compatible elbow orthosis (still needs to be modified).
- Senior Design Project
- Will be redesigned.

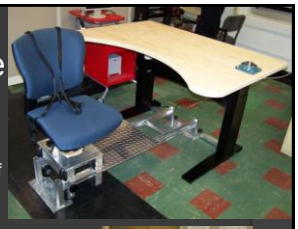




BiADLER Requirements

- Chair and Table Set-up
  - Accommodate children of various sizes
  - Accommodate tasks in horizontal and vertical plane
- Robots (including Orthosis)
  - Mount to Desktop
  - Accommodate subjects with left or right arm impairment.
  - Shall not obstruct or restrict the Activities of Daily Living task performed in the ADLER workspace
  - Must measure and assist wrist position accurately throughout an ADL task. Static and dynamic accuracy must be better than 0.5 inch (12.7mm).
  - Measure at least 3-axis forces at end-effector (accuracy 0.01 N);
- GUI
  - Support forces at end-effector between 25 to 50N;
    - Support assistance or resistance or adaptive control
    - Support arm against gravity
  - Collect wrist position at the same rate as the ADLER system. (500Hz and force position at 1000 Hz)

Chair and Workspace



- The chair has a harness and is on custom rails to allow it to be easily positioned to accommodate subjects of different sizes.
- It is aligned to the midline of the table and is height adjustable.
- Transfer in and out of the chair is made easy with a custom swivel mechanism. The table top is 5 feet in width and is custom shaped to be comfortable for subjects.
- The table (ConSet 501-11 8B116) itself is height adjustable and can be lowered or elevated to accommodate subjects.

Chair and Workspace Next Steps

- Work with therapist to create a child attractive table top with some workspace templates for activities.

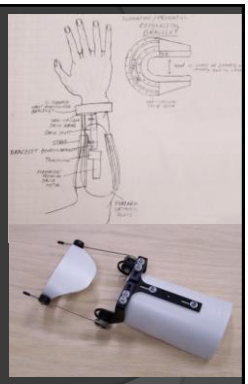
Robot: Initial Mock-up and 1st Prototype

Robot

- The robot has three active degrees of freedom (DOF).
- The base is a revolute joint that will rotate about 180 degrees (±90 degrees).
- The shoulder joint is also a revolute joint that will rotate about 80 degrees (-30 and +50 degrees).
- The final joint is prismatic and will translate about 22 inches.
- We have design for orthosis

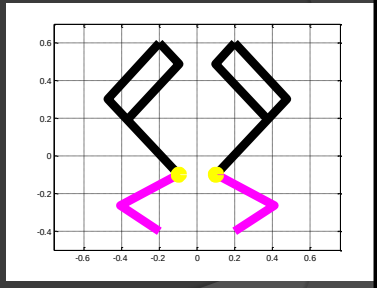
Robot Next Steps

- **Robot positioning portion:**
  - Complete in aluminum and anodize
  - Purchase and add motors and position sensors and data acquisition boards.
  - Complete 2nd robot.
  - Pursue patenting possibilities with MSOE and MCW
- Orthosis
  - The current orthosis attached on the end of this robot system by a passive 3 DOF cradle (This is not the final one)
  - The goal is to have an orthosis with 4 DOF. Two DOF will be active to allow assisted wrist roll & flexion and extension. Yaw and pitch will be passive DOF.



GUI and Controller

- We developed a BiADLER version of the MIT-MANUS Software Model
- We modified developed a robot model of the human arm and integrated it into robot software model.



GUI Next Steps

- We are in the process of purchasing the computer system, monitor, and monitor holder. This will be done by September 2011.
- We will be hiring a graduate student assistant to aid us this fall and hope to have a permanent student assistant by the spring.
- Complete robot software model
- We will implementing adaptive assistance design for this system.