Galen Controller Transparency Optimization Project Required Tasks and Task Reliance

Most tasks for the project are divided into 4 groups, each of which is primarily dependent on the previous group of activities completion. Groups 1 and 2 can be done independently if a MATLAB Installation with Simulink and the correct environment tools are available to start group 2 tasks. Group 3 is dependent on groups 1 and 2's completion. Group 4, if time allows, is dependent on the completion of Group 3. For an expected completion time frame for each task see TOGAC_D_GalenTransparencyControlGanttChart.xlsx.

Group 1: (Tasks 1.1 done in Parallel with tasks 2.1)

Task 1.1) Connect and Familiarize with AMBF and MATLAB Environment for Simulation (1 Week)

Install Software, Load in Current Galen Robot

Task 1.2) Update Simulated Galen Robot Dynamics (1 Week)

Observe Real World Dynamics and Add More Realistic Model to Simulation

Group 2:

Task 2.1) Brainstorm Methods for Implementing Simple Admittance Controller and Choose Transparency Metrics (1 Week)

Develop Basic Idea of Key Attributes Required for Controller Such as Control Diagram and Key Concepts

Task 2.2) Implement a Linear Controller Modeling the Galen as Mass Spring Damper in MATLAB Simulink Simulation (1 Week)

MATLAB Simulink Simulations for Control Systems using a Primitive Linear Model

Task 2.3) Assess and Optimize Transparency and Stability of Controller in MATLAB (2 Weeks)

Explore and Adjust Admittance, Frequency Filter, Feed Forward, Nyquist Plot and Frequency Plots

Task 2.4) Convert the Controller Plant to Robot dynamics, Update, and apply to AMBF Simulation (2 Weeks)

Change the Dynamic Model and DOF to be More Realistic of the Galen Robot, Perform Simulations in AMBF

Task 2.5) Add Virtual Fixture to the Controller in AMBF (1 Week)

Apply Virtual Constraints or a Nonlinear Approach to the Control Scheme

Group 3: **(Tasks 3.1 on going during all of tasks in group 2)**

Task 3.1) Apply Simulated Controller to Real Galen Hardware (4 Weeks)

Upload and Update Simulated Controller to be compatible and Safe with Real Hardware

UPDATED TASKS:

Task 3.3) Implement Virtual Fixtures on Real Galen Hardware (2 Weeks)

Debug Issues with the Controller on Hardware, Evaluate the Performance of the Controller on the Galen

GROUP 4 TASKS CURRENTLY ON HOLD UNTIL A LATER TERM

Group 4: **(Task 4.1 will require an IRB and that will be an ongoing process beginning February 8th. The Application should be submitted by Feb 24th at the latest)**

Task 4.1) Design User Study for Testing New Galen Controller with Respect to the Current Controller and Obtain IRB Approval (1 Week)

Design Tests, Data to collect, Number of Necessary Users

Task 4.2) Recruit Users and Perform Testing (2 Weeks)

Advertise and Find People to Assess Controller Performance

Task 4.3) Analyze Data and Conduct Further Research/Write Paper (1 Week/Post Semester)

Evaluate Collected Data, Find Story, Significance, and Application of Work, Aim to Publish and Write-Up Work.