HEMODYNAMIC SIMULATOR II
P09026

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Design Review Feedback

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System Level Design Review

Feedback

Overall:

- Develop a system dynamic model
  - Meeting with Dr. Kempski
- Risk assessment of the overall system
- Design a simple prototype

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System Level Design Review

Feedback

Control System:

- Use SIMULINK instead of PSpice for dynamic system modeling
  - Consider Windkessel model
- Identify operating parameters of the system
- Re-define input parameters

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System Level Design Review

Feedback

Pump Design:

- Revisit compliance between pump actuator to pressure and flow generated
- Cam vs. Linear Actuator
  - Meeting with Dr. Day
- Measure resistance and compliance (physical)

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System Modeling (Meeting w/ Dr. Kempski)

- Started Fluid Resistance Model
- Evaluated various research findings
  - Modeling and Simulation of Heart Pump for Controller Development
- Discussed ways to develop a Transfer Function (TF)

Overall System Sketch

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Resistive Element (Meeting w/ Dr. Day)

Resistive Element	Pros	Cons
Orifice plate	Multiple plates provide variance in resistance	Changing of plates requires drainage of system
		Pricy to purchase/timely to make
		May add turbulence
Laminar flow element	Ensure laminar flow thru the device	Expensive/ requires designing
	Can be fabricated	Non-adjustable
		Losses possible bounded by the material available
" Globe Valve"	Easy to adjust	At high head loss could trip flow to turbulent
	Readily available	Initial loss by geometry could be too great
	Can be switched to automated valve later	
	Cheap	

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Compliance (Meeting w/ Dr. Day)

Drive Systems	Pros	Cons
Pneumatic	Compliance provided by air column	If left large volume to compress actuator stroke could be too long
		and leave system response too slow
		Air could be pulsed into the water
		Compliance may to great in addition to the tube wall flex.
Air Pocket	Lowers displacement needed from actuator	Air bubbles can be forced into solution
	Lowers lag time	Hard to set up
	Less energy time/more direct actuation	Hard to drain and fill
Hydraulic w/vent. compliance	Direct action on working fluid.	Possible pressure spike
	Lowest lag in the system	Loss to verticle head
	Compliance @ vent. allows air to rise out of water	
	Smaller actuator displacement	
	Simplifies dynamic model	

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Summary (Meeting w/ Dr. Day)

Resistive Element
Due to laminar flow element and the orifice plate having to have the system drained and aren't adjustable without replacement a manual globe valve is the choice for our system.
Pump Concepts
Hydraulic With Ventricular Compliance: Must have compliance built off ventricular chamber or in the system between pump and ventricle chamber.
Pneumatic
Compliance supplied from air and volume or air directly affects compliance and lag. Too much of either will be detrimental to the system. Control of the air volume between pump piston and fluid interface will control compliance and lag.

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Bill of Materials

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Electrical BOM					
Item	Quantity	Manufacturer	Part #	Price	Description
Pressure Sensors	3	Omega		$ 0.00	Inherited from P08026
	2	Edwards Life sciences		$0.00	Donated by Dr. Schwarz
Flow Meter	1	Omega		$250.00	P08026
Controller	1	Pacific Scientific		N/A	P08026, **Will not be used**
DAQ	1	Measurement Advantage	miniLAB 1008	$50.00	Jonathan

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Mechanical BOM

Item	Quanitity	Manufacturer	Part Number	Price	Description
ServoDrive-Computer Cable	1				Cable to connect the Actuator to the computer
Servo Drive	1				Actuator - Specs determined, in contact with suppliers
Servo Drive- Servo Cable	1				
Servo-Air Piston Connection	1				Connector for Actuator to cylinder connection
Air Piston	1	None		N/A	Modified previous air cylinder to be compatible with our design
Tygon Tubing					Tubing used in the system
Tubing Fitting					Fittings needed to secure tubing
Buffer Chamber	1	None		N/A	Will use the chamber from the previous design
Heart Chamber	1	None		N/A	Donated from Dr. Schwarz
Compliance Chamber	1				Compliance chamber to be mounted on top of the heart chamber
Quick Disconnect	1				Valve to allow for connection of other medical devices
Globe Valve	1				Used for the resistance in the system
Reservoir Chamber	1				Chamber design in process
Heart Stand	1				Joe will be designing and manufacutring
Mounting Plates for Actuator/Cylinder Combo	1				Mark will be designing
Cart	1	None		N/A	Donated from Dr. Schwarz

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Feasibility

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Actuator Specifications

- Page 1
- Page 2
- Page 3

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Risk Assessment

Risk Assessment (Rev. 3)

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Questions ?