

Flywheel Meeting Minutes

14 September 2016

Present: Dr. Herb Hess, Dr. Feng Li, Justin Pentigill, David Arnett,
Shea Morrison, Nick Bachus, Matt Phillips, Kyle Peterson, Cooper Atkinson,
Ian Tanimoto, Andrew Jones, Brian Cartwright,

ECE Conference Room @ 3:30PM

- Thesis will be distributed by David Arnett to each team member
 - Each person will be expected to read and explain their theses to the group within the next 2 weeks
- Have a discussion on the idea of having 1 or 2 Portfolio's at the end of the year
- Treasurer: in charge of orders / reimbursements ISGC (Dealing with Finance Officer Renee)
 - Kyle Peterson
- Moderator: sets agenda, prepares for meeting, takes minutes (make rotating)
 - Shea Morrison first with client interview : make agenda & email out by Wednesday, September 21st meeting
- Portfolio: constructs and keeps teams portfolio, organizing throughout the year
 - Matt Phillips
- Wikipage: makes and updates wikipage for team
 - Have someone from each major to be able to explain in detail
 - Brian Cartwright (CS) & Shea Morrison (EE) & Nick Bachus (ME)
- Client Interview needs to be done by the end of next week
 - Specifications product
 - Make a transcript of meeting to define what is wanted / needed from the team
- Meeting tomorrow (Thursday, September 15th) to complete & sign Team Contract

Meeting Concluded @ 4:30 PM

Lunar Flywheel Client Interview - Minutes

Wednesday September 21 2016

Present: Dr. Herb Hess, Dr. Feng Li, Justin Pentigill, David Arnett,
Shea Morrison, Nick Bachus, Matt Phillips, Kyle Peterson, Cooper Atkinson,
Ian Tanimoto, Andrew Jones, Brian Cartwright

GJ 218 Conference Room
Meeting Commenced 3:30PM

- Discussed the splitting of the members into two teams: "Controls Team" and "Stator Design Team", with separate portfolios, goals, deadlines, posters, and presentations.
- Discussed design specifics of the stator and the flywheel itself, as well as safety precautions for the future tests of the full scale high speed prototype.
- Discussed the OneDrive managed by the department (not the OneDrive managed by the team).
- Further discussed the stator, and briefly discussed responsibilities of the controls team.
- General discussion of design specifications.
- Finalized discussion of teams and portfolio.

Meeting Concluded 4:30PM

Lunar Flywheel Client Interview - Transcript

Wednesday September 21 2016

Present: Dr. Herb Hess, Dr. Feng Li, Justin Pentigill, David Arnett,
Shea Morrison, Nick Bachus, Matt Phillips, Kyle Peterson, Cooper Atkinson,
Ian Tanimoto, Andrew Jones, Brian Cartwright

GJ 218 Conference Room
Meeting Commenced 3:30PM

- How many portfolios should this senior design have in the end?
 - o The team should submit two portfolios at the end of the year. One for the stator design team and one for the controls team. Each subgroup will have their own portfolio keepers. These keepers will be Matt Phillips for the stator design group and Andrew Jones for the controls group.
- What are the project deadlines/ milestones?
 - o Generally stick with the senior design guidelines

- Each of the subgroups will need to make their own outlines and priorities.
- Any specific design specifications?
 - Speed should be between 25,000 to 30,000 rotations per minute with approximately 100x the amount of energy storage as the low speed.
 - Models need to be adjustable with variables; nothing should be hard coded.
 - The stator design team should strictly focus on the model for the stator and nothing else.
 - Weight of the stator is not a concern but should be within reason. Material price and manufacturing are the bigger factors.
- Will we be doing any 3D modeling of the stator and/or the rotor?
 - A model in Solidworks would be good for visualization
 - Keep manufacturing and machining in mind but the teams will not need to focus on building it. This senior design team's main goal is to design a model to guide the construction.
- What are the available resources, tools or programs
 - ANSYS, Simulink, Matlab, FEMM, MathCAD
 - All of the existing models can be found at: ShareDrive>Senior Design>Group Folders>Flywheel
- What are the controls systems requirements?
 - Verify what has already been done. Evaluate what parts of the algorithms and sensors will need to be updated/redesigned for the high speed design.

Client Interview approval signatures:

X

David Arnett
Team Grad Student

X

Justin Pettingill
Team Grad Student



Dr. Herb Hess
Client

Lunar Flywheel weekly meeting- Minutes

Wednesday; September 28, 2016; 3:30pm

Present: Dr. Herb Hess, Dr. Feng Li, Justin Petigill, David Arnett, Nick Bachus, Matt Phillips, Kyle Petersen, Cooper Atkinson, Ian Tanimoto, Andrew Jones, Brian Cartwright

Absent: Shea Morrison

GJ 218 Conference Room

Moderator: Ian Tanimoto

Update from weekly Tuesday Meeting with Dr. Berven

Expectations (for larger project context):

Low Speed

- Balance Flywheel Mount Position sensors (requires design of mounts)

- Resolve issues with flywheel hitting resonant frequency

- Hoses for Liquid Nitrogen/water coolant

- Thermocouples installed

- Purchase rotational position encoder

- Program user interface

High speed

- Stator Design, Controls system

- Come up with goals/standards (senior design) soon

- Weekly updates on all work

- Fail safe design

Work spaces will be cleared in lab for teams to work

Shea and Nick will have keys to lab soon

Senior Design Items

Client Interview transcript/target specs due tomorrow (9/29)

Ian needs to be added to email list

MEs met last week to discuss what input parameters they need to generate model

EEs work last week on permeability calculations (needs to be re-worked to have accurate numbers)

Professional version of Ansys may be available through Dr. Tao Xing

Everyone now has access to Shared Drive through UI network

Presentations for theses sections

Nick Bachus- Ch. 8: Dynamic model from Bridget Wimer's thesis

Matt Phillips- Ch. 5: Mechanical Design from Bridget Wimer's Thesis

Kyle Petersen- Ch. 3: Stress/displacement model from Brenden Kaschmitter's thesis

Cooper Atkinson- Senior Design Final report from 2011-2012

Next week:

Finish up presentations

Meet with individual teams

Logbooks due next Tuesday

Lunar Flywheel weekly meeting- Minutes

Wednesday; October 05, 2016; 3:30pm

Present: Dr. Herb Hess, Dr. Feng Li, Justin Pettingill, David Arnett, Nick Bachus, Matt Phillips, Kyle Petersen, Cooper Atkinson, Ian Tanimoto, Andrew Jones, Brian Cartwright, Shea Morrison

Absent: None

GJ 218 Conference Room

Moderator: Kyle Peterson

Minutes: Andrew Jones

Updates:

Stator Design

Scheduling a group meeting on Thursday at 3:30pm (library) to discuss laying out model framework

Kyle and Nick have been working with Justin on strain testing for chopped fiber toroid

Electrical team will perform controls on an iron core with known permeability

Controls

Analyzing existing code – most student-written code in main.c files

Update from weekly Tuesday Meeting with Dr. Berven

Expectations (for larger project content)

Finalize the Low Speed model so we can focus exclusively on the High Speed model

Test existing code

Fully understand control structures (rotation algorithm, current control)

Justin and David are looking into getting a SimScape license for Simulink for simulating the overall model

Other Updates

Discussed budget with Dr. Hess (budget authority being transferred from Law to Hess)

Senior Design Items

Snapshot Day is Tuesday, Oct 11 (GJ 102)

Focus on project definition and outline

Logbook Review – turn in to Dr. Li by COB Friday, Oct 14

Presentations for theses sections

Andrew Jones – Kisling Chapter 6 – AMB Control System

Brian Cartwright – Energy Transfer / FRRM Control

Shea Morrison – Passive and Active Magnetic Bearings

Next week:

Lunar Flywheel weekly meeting- Minutes

Wednesday; October 12, 2016; 3:30pm

Present: Dr. Herb Hess, Dr. Feng Li, Justin Pettingill, David Arnett, Nick Bachus, Matt Phillips, Kyle Petersen, Cooper Atkinson, Ian Tanimoto, Andrew Jones, Brian Cartwright, Shea Morrison

Absent: None

GJ 218 Conference Room

Moderator: Andrew Jones

Minutes: Matt Phillips

Updates:

- Stator Design Team:
 - Electrical team will be re-running the experiment later today
 - Mechanical team has finished the material testing for Justin
 - Matlab licensing issues has caused issues with running experiments for Justin
 - Justin is trying to get his license upgraded to the research version
 - Justin will be giving a summary of his data next week
 - Met last week:
 - Create a general idea for inputs of the model
 - How each model will relate to each other
 - Mechanical team will look into getting Matlab to communicate with ANSYS.
- Controls Team:
 - Met yesterday morning to go over the code but spent most of the time going over snapshot requirements.
 - In the review session they found some of the main loop code but it is poorly commented.
 - David is looking for the microcontrollers that the code is running on

Update from weekly Tuesday Meeting with Dr. Berven

- Dylan has given a number for the force per area of the magnets
 - This number is set at a certain gap distance
- Running the liquid nitrogen through the stator will cause evaporation
- Task reports for Tuesday meetings need to be submitted by Monday at 5pm
- Design the system to work in Earth conditions not moon conditions
- Dylan's email: more6526@vandals.uidaho.edu

Budget Update:

- \$2000 for hardware costs and \$500 for software costs.
- We already has licensing for Power Systems.
- Dr. Law approved the budget
- Budget breakdown is on the onedrive.

Other Updates

- Ask Dr. Berven to get keys to the lab. One per group.
- Need to get a group photo for the poster and portfolio

Senior Design Items

- Logbooks due Friday October 14th to Dr. Li (Box outside his office)
- November 4th the first wiki page draft is due.
- Design Review is the two weeks before Thanksgiving. Need to choose a date early to make sure we get a good time.

Presentations for theses sections

Andrew Jones – Kisling Chapter 6 – AMB Control System

Ian Tanimoto – Kisling Chapter 5 – Control Algorithms

Next week:

Lunar Flywheel weekly meeting- Minutes

Wednesday; October 19, 2016; 3:30pm

Present: Dr. Herb Hess, Dr. Feng Li, Justin Pettingill, David Arnett, Nick Bachus, Matt Phillips, Kyle Petersen, Cooper Atkinson, Ian Tanimoto, Brian Cartwright, Shea Morrison

Absent: Andrew Jones (interview)

Late: None

GJ 218 Conference Room

Moderator: Matt Philips

Minutes: Cooper Atkinson

Updates:

- Stator Design Team:
 - Electrical Team
 - Toroid testing (Round1) is complete
 - Reference testing verified that testing method was proper
 - Instruments of insufficient accuracy to properly measure permeability of composites since it is so close to free space.
 - Going forward, look for other testing options/devices to obtain more accurate values
 - These values will be useful in figuring out the magnetic losses in the rotor
 - Justin is exploring powder composites that may work better than our current formula.
 - Maximize amount of iron powder in the composite
 - FEMM software may potentially be used for electrical FEA
 - Mechanical Team
 - Composite tensile testing complete
 - Experimental procedure is in progress
 - Is there a specific format for the procedure?
 - Data analysis will be done in conjunction with a class projects
 - Dr. Bob Stephens meeting
 - Gave direction to what fatigue models should be used
 - Gave some resources to check for reversed torsional fatigue.
 - What would we consider “long life”
 - Factor of safety to be based on life and should be about 2-3
- Controls Team:
 - No hardware updates – Andrew has had other commitments
 - Downloading and looking at the control suite
 - Reading documentation about available libraries
 - More info on microcontrollers coming next week

Update from mentors (Justin and David):

- Justin
 - Test results for composites complete
 - Results make sense – sent to major professor for review
 - May need some additional points
 - Strengths sufficient for flywheel – all
 - Going forward, optimize the mixture more for the electrical properties, since the mechanical properties were more than sufficient for all mixtures tested.
- David
 - Microcontrollers – Delfino 335 and 77D
 - Only have one spare of each, looking at buying more
 - 335=\$65 each
 - 77D-discontinued - now the 790
 - 790 has extra features that could be useful (\$219 per kit)
 - Or \$169 for just the control card
 - Power supply hasn't been specified, but power electronics wanted 80 MHz frequency with operational region of 12-44 volts
 - Target for power supply
 - Need to find the previous power electronics...
 - H-bridge rectifiers (drive current through the coils)
 - Appeared as though hysteresis control was attempted for implementation

Update from weekly Tuesday Meeting with Dr. Berven

- Material discussed at the meeting has already been covered in the discussion above.
 - NASA conference room in BEL

Other Updates:

- Need to complete task report for Dr. Berven meeting prior to COB Monday

Senior Design Items:

- Wiki page lecture Tuesday (3:30 in GJ 114)
- November 4th the first wiki page draft is due.
- Design Review is the two weeks before Thanksgiving. Need to choose a date early to make sure we get a good time. (MUST BE DONE BEFORE FRIDAY, NOVEMBER 18TH)

Lunar Flywheel weekly meeting- Minutes

Wednesday; October 26, 2016; 3:30pm

Present: Dr. Herb Hess, Dr. Feng Li, Justin Pettingill, David Arnett, Nick Bachus, Matt Phillips, Kyle Petersen, Cooper Atkinson, Ian Tanimoto, Brian Cartwright, Shea Morrison, Andrew Jones

Absent: None

Late: None

GJ 218 Conference Room

Moderator: Cooper Atkinson

Minutes: Nicholas Bachus

Updates:

- Stator Design Team:
 - Electrical Team
 - Toroid testing is still in progress and Shea did some more research on the test procedure
 - Met with the ME team to discuss heat transfer ideas
 - Mechanical Team
 - Came up with preliminary heat transfer ideas
 - Did rough Solidworks heat transfer simulation for the stator with the caps and without the caps. The caps were more efficient while the single bore will be sufficient
 - Figure out date for shop training
 - Kyle Peterson started a simple TK code for the fatigue calculations
- Controls Team:
 - Andrew did research on the Texas instruments design drive implementation for the controls code. Does not think it will be applicable for the FRRM.
 - BiSS protocol, found an encoder from the 2012 design team, but can't find the model online.

Update from mentors (Justin and David):

- Justin
 - Found information for permeability for composite materials.
 - Ordered a book "Axiomatic design and fabrication of composite structures"
 - Book goes over how to model a composite rotor
 - Found information explaining how the higher resistance the rotor has from the composite material, the lower the eddy current losses there are.
- David

- Talked to Dr. Berven about getting space in the IRIC. Dr. Hess has possibly already started to work towards getting the flywheel research project a lab.

Update from weekly Tuesday Meeting with Dr. Berven

- The resin epoxy coating is an insulator for the coils and Nick included it within his heat transfer simulation for the caps by adding a small film of plastic (PVC).
- David pitched using a position encoder for the flywheel to Dr. Berven

Other Updates:

- Shea, Nick, and Brian will be working on our respective wiki pages. The rough drafts are due November 4th.

Senior Design Items:

- November 4th the first wiki page draft is due.
- Design Review date will most likely be on November 11 from 2:30-4:30. Email Dr. Berven to see if she will be able to attend.
- Schedule picture for wiki pages

Lunar Flywheel weekly meeting- Minutes

Wednesday; November 2, 2016; 3:30pm

Present: Dr. Herb Hess, Dr. Feng Li, Justin Pettingill, David Arnett, Nick Bachus, Matt Phillips, Kyle Petersen, Cooper Atkinson, Ian Tanimoto, Brian Cartwright, Shea Morrison, Andrew Jones

Absent: None

Late: None

GJ 218 Conference Room

Moderator: Nicholas Bachus

Minutes: Brian Cartwright

Updates:

- Stator Design Team:
 - Electrical Team
 - Figured out permeability error; units confusion. After conversion to correct units, the results make sense.
 - New toroid was about 5/10ths higher than previous
 - Exact results to be uploaded to the OneDrive
 - Starting research into quadratures.

- Mechanical Team
 - Fatigue TK code: recently done code for inner diameter <-> heat transfer, and force <-> outside diameter. Want to expand further to incorporate keyholes, step locations, etc. Determining stress intensity. Gut feeling: it'll be fine. Want to combine with heat transfer calculations.
 - The use of a shaft in the High-speed Flywheel is debated. Dr. Hess proposes a shaftless design: laminations provide structure, thin coating between coolant and windings, material would need to have high thermal conductivity and be non-ferrous. Potentially smaller inner radius as a benefit.
 - Heat transfer calculations ongoing, modeling stator teeth and rotor chevrons as fins. End result should be usable in simulations to verify.
 - Review cooling caps: Pros: higher efficiency, Cons: More complex, a bit overkill. Probably only need the single-bore shaft-cooling since it stays room temp. If there is too much heat, it's a good idea. Thermal paste could help. 100W was the given ballpark heat losses, probably worst-case scenario. ~50W is realistic.
- Controls Team:
 - Looking into dual-core capabilities of the 77D microcontrollers. May potentially offload one of the other processors' workloads onto the 77D/79D. Also, 7xD has CLAs, more offloading is possible.
 - ControlSUITE may have example code taking advantage of this. Most of it is probably under the GNU open license.

Update from mentors (Justin and David):

- Justin
 - Talking with Berven about purchasing ANSYS for analytical models for stress concentrations, especially the chevrons. Currently using ANSYS student version, which is free but not publishable. Will request quotes.
 - Working on validating Brenden's model, so far it looks valid to within 1 or 2%.
 - Dillon will be doing Maxwell equations for halbach arrays, might be similar software
- David
 - Needs for the current machine to operate:
 - 1.1-1.2 tesla range is their operating/saturation point
 - d: bias current 1.75 amps +/- 0.7A control
 - q: 1.67A (these figures are in the theses tables)
 - sizing power supply- assume sum of each
 - 2.6A bias current +/-1A control signal
 - still looking into power electronics configuration
 - Remember saturation for stator design
 - In initial stages of paperwork for getting room in the IRIC. More info next week. People in general start moving in January 1st.

Update from weekly Tuesday Meeting with Dr. Berven

- Showed Dr. Berven cap simulation results, she says proceed with single-bore. She approves of heat analysis techniques.
- We have videos of the setup in action, Brian will post on OneDrive.

Other Updates:

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Senior Design Items:

- Wikis are due 5pm the 4th, email when done.
- Scheduling stator design's design review
 - Data sheets, real things are good, keep PowerPoint minimal. Combinations are good.
- Ian and Dr. Hess still need to fill out Control team scheduling doodle poll.
- Design review level of detail from Dr. Hess:
 - What you're doing
 - What your task is
 - What you've done so far
 - "How you plan to land this thing."
 - Any issues you need to discuss
 - "Circuit diagrams labeled with numbers are great."
 - "Prove you've gotten as far as you've got. Don't let me believe you haven't done anything."
 - In this case, background information should be minimal.
- Scheduling group picture after class Friday.

Flywheel Meeting Minutes		November 9th, 2016
GJ 218 Conference Rm. 3:30pm		

Moderator: Brian Cartwright

Minutes Taker: Shea Morrison

- **Updates from Teams**
 - Stator Design Team Updates
 - Electrical team
 - Created a model that outputs force per coil – Matt Phillips
 - Chapter 7 in Wimer's thesis
 - Basic MatLab script to create Force created by each coil in FESS
 - Mechanical team
 - Working on heat transfer models for new designs. - Cooper Atkinson
 - Heat Transfer research, talked to John Crepeau
 - Fins with no conventions
 - Nick Bauchus : Cooling caps in more ideas

- Thermal grease – thermally conductive, electrically insulated, cheap
 - Make sure to check life span – stop being thermally conductive after some time – David Arnett
- Strom Electric, in Troy, ID for research on resin used on stator. Need material property
- Kyle : Shaft changes and ideas
 - Working on solid works models
 - Looking at full range of designs – discussing in design review
- Dr. Hess : talk to Rachel under Dr. Ralm
 - Good with material testing
 - Invite her to design review Friday
- Controls team
 - Still reviewing the whole system from the top down
 - Hysteresis, Bang-bang, and PID schemes have different places
 - Sources using Hysteresis & Bang-Bang control interchangeably
 - Can use a Bang-Bang to create a Hysteresis
 - Found and compiled dual-core example code
 - It's two separate source files and executables
 - 2 processors on same card – part of optimization
 - DMA to help cores talk
 - Look into code in order to shuffle information in and out of the DMA
 - Found a guide, theoretically ready to test it on one of our 7xDs
 -
- **Updates from Mentors (Dr. Hess, David, Justin)**
 - David : finishing paperwork for IRIC, submitting later today
 - Justin : in contact with Dr. Tau to get ANSYS licenses. Approx \$11.3k to split between professors. Advance Package = 25 research seats with 250 teaching seats for \$15k.
 - Hess, Zadehol, Tau, Budwig, Kamar, Zing interested professors in order to contact and discuss options. Also see if any other professors from separate University affiliates from Boise, Twin Falls, Coeur D'Alene branches are interested to split cost even more. Meeting 4:00 PM Friday to discuss.
- **Tuesday Meeting Updates**
 - Update from meeting with Dr. Berven
 - Hopefully still attending Design Review for Stator Team
 - Friday @ 3:00PM in ECE Conference Room

- **Updates from Senior Design (Dr. Feng Li)**
 - Controls team still scheduling design review date, waiting on Dr. Hess
 - Feng Li's Optional PCB workshop on the 15th, RSVP

- **Next meeting review (16 November 2016)**

Moderator: Shea Morrison

Minutes Taker: Ian Tanimoto

- **Adjourn**

Flywheel Meeting Minutes		November 16th, 2016
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GJ 218 Conference Rm. 3:30pm

Moderator: Shea Morrison

Minutes Taker: Ian Tanimoto

- **Updates from Teams**
 - Stator Design Team Updates
 - Electrical team
 - Updates from meeting with Justin on Monday about the results of the permeability testing and whether or not the composite is viable - Matt
 - Mechanical team
 - Solidworks simulations discussion - Kyle
 - Updates - Nicholas
 - Controls team
 - Preparation for design review, creating graphs – Brian
- **Updates from Mentors (Dr. Hess, David, Justin)**
 - Reminder: IRIC tour on Thursday November 17 – David
- **Tuesday Meeting Updates**
 - Update from meeting with Dr. Berven
- **Updates from Senior Design (Dr. Feng Li)**
 - Reminder: logbooks due December 9th.
 - Reminder: team member citizenship forms due Friday November 18th.
 - Reminder: Peer reviews are due Friday November 18th.

- Reminder: Snapshot expo is Friday after break.
- **Next meeting review (November 30th 2016)**
 - Moderator: Ian Tanimoto
 - Minutes Taker: Kyle Petersen
- **Adjourn**

Flywheel Meeting Minutes		November 30th, 2016
GJ 218 Conference Rm. 3:30pm		

Moderator: Ian Tanimoto

Minutes Taker: Kyle Petersen

Present: Andrew Jones, David Arnett, Shea Morrison, Dr. Herb Hess, Nick Bachus, Cooper Atkinson, Justin Pettingill, Dr. Feng Li, Brian Cartwright, Matt Phillips, Kyle Petersen

- **Updates from Teams**
 - Stator Design Team Updates
 - Electrical team

Have produced a permeability linearization (results passed out in hard copy)

Need ~80% Iron to make effective

Composite does not look like it will satisfy requirements

Need to verify theoretical models of composites are manufacturable

Justin tried two different models for strength (results: 75% Iron -> 24Mpa strength) Solid Iron->280 Mpa

Justin is still going through model and looking into all composite aspects

 - Mechanical team

Nick Met with Rachel Peterson to discuss cooling options (recommendation is solid core heat sinks)

Cooper is still working through fin equations

Thermal model will be done by using parallel resistances w/ constant temp

Nick got a hold of strom electric to discuss coil insulation (Max temp= 200C)

Fatigue model will drive heat transfer, then they will be verified

- Controls team

Design review was completed

Ready to move into coding phase

- **Updates from Mentors (Dr. Hess, David, Justin)**

- David
 - Looking at encoder
 - Getting selectin verified with Dr. Berven
 - No real reason for why it won't work
 - 4x higher resolution than needed
 - 6 week, 4 day order time (now is the time to order)
 - Need to look at encoder mounts
 - Hope to be testing by early Feb.

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- Justin
 - Talking with Dr. Xing about Ansys license
 - Team contribution ~\$1200
 - Optimization of composite underway
 - Collecting more data
 - By spring semester: pick material path to finalize testing
 - Mass added as a constant
 - Moment of inertia of x, y must be balanced

- **Tuesday Meeting Updates**

- Update from meeting with Dr. Berven
 - Pursue copper heat sink design
 - IRIC space request has been submitted (very optimistic)
 - Looking into phase II paperwork
 - Safety office has training/videos to watch

- **Updates from Senior Design (Dr. Feng Li)**
 - Snapshot #2 is on Friday(12/9) 8:30-10:30
 - 10:50 flywheel 2nd semester team is presenting
 - Controls team must be present
 - Same place as previous snapshot
 - Must have: Goals, work accomplished, current state, future

- **Other Updates**

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- **Next meeting review (7 December 2016)**

Moderator: Kyle Petersen

Minutes Taker: Andrew Jones

- **Adjourn**

Flywheel Meeting Minutes		December 07th, 2016
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GJ 218 Conference Rm. 3:30pm

Moderator: Kyle Peterson

Minutes Taker: Andrew Jones

Present: Andrew Jones, David Arnett, Shea Morrison, Dr. Herb Hess, Nick Bachus, Cooper Atkinson, Justin Pettingill, Dr. Feng Li, Brian Cartwright, Matt Phillips, Kyle Petersen

Late: N/A

Absent: N/A

- **Updates from Teams**

- Stator Design Team Updates
 - Electrical team
 - Monday meeting (Matt, Shea, David, Justin)
 - Matt: Gaining better understanding of equations
 - How permeability changes them
 - Shea: grad student will give in-depth explanation of block diagram models
 - System needs to be transitioned to single phase machine
 - Mechanical team
 - Kyle: Address how assembly of system will affect fatigue calculations
 - Preliminary calculations on shaft: 1.5 – 2 inches Stainless Steel (LS = 1 inch)
 - Inside diameter: 0.75 inches
 - Change could affect electrical calculations

- Nick/Cooper: trying to get a heat transfer model across the stator
- Controls team
 - Attending FlyCAM's last meeting tomorrow (Thurs, Dec 08)
 - Eric Silk will review GUI with the team
 - Over break: can perform sanity checks on existing code
- **Updates from Mentors (Dr. Hess, David, Justin)**
 - David
 - Encoder ordered; should ship in 6-7 weeks
 - Generating list of deliverables for electrical and computer team members for beginning of S17
 - Will be emailed out by Friday
 - IRIC space secured, planning move in
 - Will email building guidelines
 - Justin
 - Helped David with the encoder
- **Tuesday Meeting Updates**
 - Update from meeting with Dr. Berven
 - Confirmed use of copper heat sink caps above and below stator
- **Updates from Senior Design (Dr. Feng Li)**
 - Portfolios and logbooks due to Dr. Li – Friday COB
- **Other Updates**
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- **Next meeting review (W/O January 09, 2017)**

Moderator: Andrew Jones

Minutes Taker: Matt Phillips
- **Adjourn**

Flywheel Meeting Minutes		January 25th, 2017
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IRIC 105 Conference Rm. 3:30pm

Moderator: Andrew Jones

Minutes Taker: Matt Phillips

Present: Andrew Jones, David Arnett, Shea Morrison, Dr. Herb Hess, Nick Bachus, Cooper Atkinson, Justin Pettingill, Dr. Feng Li, Brian Cartwright, Matt Phillips, Kyle Petersen

Late: N/A

Absent: N/A

- **Updates from Teams**

- Stator Design Team Updates
 - Electrical team
 - Matt is working on the mathematical connection between the winding function and induced torque on the rotor.
 - Shea is working on putting the equations into Simulink
 - Mechanical team
 - Kyle is in the process of figuring out shaft displacements and shaft diameter output from model. Trying to figure out connection between torque and diameter
 - Cooper and Nick are working on ANSYS and heat transfer model
- Controls team
 - Andrew is looking in Ramus' thesis on how the MCU's are connected to the power electronics. Looking into power/current demands and signal communication types between the two.
 - Brian developed a main loop for the drive bearing (pseudo code)
 - Ian used pseudo code for the stabilizing bearing

- **Updates from Mentors (Dr. Hess, David, Justin)**

- David
 - Got an email from Renshaw about the shipment of the encoder (3 days to a week shipping time).
- Justin
 - Working with Kade on putting the encoder together
 - Been collecting data and writing his thesis also!
- Hess
 - Dr. Xing sent the details out yesterday
 - ANSYS details will be available in about three days
 - No funding will be necessary from our team
 - There is an open house next week (Tuesday the 31st). Media sessions on Monday and Thursday (Regional News).

- **Tuesday Meeting Updates**

- For the team, still working on safety things to be able to work in the IRIC lab space. Expect an online safety "quiz" in the next couple weeks.

- **Updates from Senior Design (Dr. Feng Li)**

- Detailed design review next week.

- **Other Updates**

- Electrical and Mechanical design reviews will be separate.

- **Next meeting review (W/O January 09, 2017)**

Moderator: Matt Phillips

Minutes Taker: Cooper Atkinson

- **Adjourn**

Flywheel Meeting Minutes		February 1st, 2017
IRIC 105 Conference Rm. 3:30pm		

Moderator: Matt Phillips

Minutes Taker: Cooper Atkinson

Present: David Arnett, Shea Morrison, Dr. Herb Hess, Nick Bachus, Cooper Atkinson, Justin Pettingill, Dr. Feng Li, Matt Phillips, Kyle Petersen

Late: Dr. Herb Hess

Absent: Brian Cartwright, Andrew Jones

- **Updates from Teams**

- Stator Design Team Updates
 - Electrical team
 - Shea – looking into Lipo's research to get more FRRM info.
 - Matt – Alpha function no longer has to be a function of frequency
 - Simplifies further calculations.
 - Still working on getting saw tooth waveforms
 - Mechanical team
 - Heat transfer EES code working
 - Verified by Justin, Rick and Solidworks
 - Portion of fatigue code working. Outputting diameters properly
 - Fatigue calculation for keyway under investigation
 - Differing methods
 - Meeting with Dr. Stephens to determine correct method
 - Working on ANSYS structures tutorials
- Controls team
 - Meeting to work on coding for the encoder.
 - Getting ready to look into physics of it
 - Single axis code should be working next week
 - Vertically levitating a plate.

- Theoretically would transfer directly to flywheel
 - Researching how to connect the power electronics
- **Updates from Mentors (Dr. Hess, David, Justin)**
 - David
 - Payment didn't make it for the encoder, so now we have to track down what happened
 - Justin
 - Kade has quote and manufacturing plan for mounting the encoder
 - Nick and Justin drilled holes so the plate can directly mounted on the low-speed flywheel
 - Hoping to move the low-speed flywheel in the next week or so
 - Dr. Hess
 - No updates on ANSYS
- **Tuesday Meeting Updates**
 - None
- **Updates from Senior Design (Dr. Feng Li)**
 - ME Design review: Thursday February 9th 2:30pm
 - Controls Design review: Friday February 10th at 3:30pm
 - Logbooks due end of February
- **Other Updates**
 - Get lab safety papers to David
- **Next meeting review (W/O January 09, 2017)**

Moderator: Cooper Atkinson

Minutes Taker: Nick Bachus
- **Adjourn**

Flywheel Meeting Minutes		February 8st, 2017
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IRIC 105 Conference Rm. 3:30pm

Moderator: Cooper Atkinson

Minutes Taker: Nicholas Bachus

Present: David Arnett, Shea Morrison, Nick Bachus, Cooper Atkinson, Justin Pettingill, Matt Phillips, Kyle Petersen, Ian Tanimoto, Brian Cartwright, Andrew Jones

- **Updates from Teams**
 - Stator Design Team Updates
 - Electrical team
 - MMF model working

- By next week going to have torque model done
 - Matt is planning to make a Mathcad model for verification
- Mechanical team
 - Working on fatigue and heat transfer model
 - Nick is going to purchase stainless steel bearing balls for lazy susan
 - Design review 2/9/2017 2:30pm IRIC 105
- Controls team
 - Got in contact with Brent Kisling for pinout and power electronics for single axis electromagnetic active bearing
 - Design review 2/10/2017 IRIC 3:30pm
- **Updates from Mentors (Dr. Hess, David, Justin)**
 - David
 - Payment didn't make it for the encoder, so now we have to track down what happened
 - Justin
 - Working on setting up the lab and will be putting together the low speed flywheel soon
 - Going to put building modification order for chilled water supply and electrical plug in for vacuum pump
- **Tuesday Meeting Updates**
 - None
- **Updates from Senior Design (Dr. Feng Li)**
 - ME Design review: Thursday February 9th 2:30pm
 - Controls Design review: Friday February 10th at 3:30pm
 - Logbooks due February 17, 2017
- **Other Updates**
 - Get lab safety papers to David
- **Next meeting review (W/O January 15, 2017)**

Moderator: Nick Bachus

Minutes Taker: Brian Cartwright
- **Adjourn**

Flywheel Meeting Minutes		February 15th, 2017
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IRIC 105 Conference Rm. 3:30pm

Moderator: Nicholas Bachus

Minutes Taker: Brian Cartwright

Present: David Arnett, Shea Morrison, Nick Bachus, Cooper Atkinson, Justin Pettingill, Matt Phillips, Kyle Petersen, Ian Tanimoto, Brian Cartwright, Andrew Jones, Dr Hess, Feng Li

- **Updates from Teams**
 - Stator Design Team Updates
 - Electrical team
 - Have torque model made, but not working
 - scheduled meeting with Dr Law
 - almost finished MathCAD model, still needs some debugging
 - switch case for negative coils doesn't change the graphs
 - Mechanical team
 - working on assembling low-speed
 - Working on fatigue and heat transfer model for high-speed
 - Controls team
 - had design review Friday
 - have hardware set up as much as possible
 - heard back from kevin about x-displacement pins,
 - ready to finish hooking up hardware (just need more keys)
- **Updates from Mentors (Dr. Hess, David, Justin)**
 - David
 -
 - Justin
 - Picture session from 3-5pm Thursday
 - Dr. Hess
 - We're at 11.5k / 15k for Ansys license
 - give project poster to research expo on the 24th (Monday before expo, details in email)
 - Capstone is 28th, just use the same poster for both.
- **Tuesday Meeting Updates**
 - Ordered stainless steel ball bearings, should be here next week
 - looking into more low-speed hardware
 - going to disassemble low-speed for measurements
 - working on getting rotation encoder centered
- **Updates from Senior Design (Dr. Feng Li)**
 - Logbooks due February 17, 2017
 - register for expo early
 - figure out how many tables we want, get that info to Rob
 - going to talk to Rob about holding our expo in IRIC
- **Other Updates**
 - Get lab safety papers to David
- **Next meeting review (W/O January 15, 2017)**

Moderator: Brian Cartwright

Minutes Taker: Shea Morrison

- **Adjourn**

Flywheel Meeting Minutes
3:30pm

Wednesday, 22 February 2017

IRIC 105 Conference Room

Moderator: Brian Cartwright

Minutes: Shea Morrison

- Updates from Teams
 - Stator Design
 - Mechanical
 - Keyway code completed
 - Needs to be integrated with Fatigue model
 - Dr. Stephens verified our methods
 - Stainless steel ball bearings in Lazy Susan
 - List of tools completed for IRIC – checking with David
 - Talked to Dan Schnider about baffle – only 3D printed one, which would swell with water. Therefore have to make our own out of stainless steel.
 - Electrical
 - Troubleshooting Torque Model, currently getting a 0 MMF total
 - MathCAD development completed, noticed a small error in Current Function that needs to be changed (remainder of 1 or 0 instead of 5 or 0)
 - Changed issues in Bridget's Model. Make sure to justify how issues are being fixed. Don't just say "as to be expected"
 - Control Team
 - Controls
 - Going to test uploading example code to MCU
 - Need a type A&B USB cord
 - Test stabilizations bearing and active bearing – next steps
 - Need to do inventory in order to put it all together
- Updates from Mentors
 - Justin
 - Record magnitude of B field in airgap in order to proportion it to torque of machine
 - David
 - Talking to IRIC facilities to see how much it would cost for building modifications

- Updates from Senior Design
 - Expo registration (relevant class is this Tuesday 2/28/17)
 -
- Updates from Tasks Report Meeting
 - Cade's working on mounting the sensors
- Next Meeting
 - Moderator: Shea Morrison
 - Minutes: Ian Tanimoto
 -
- Adjourn

Flywheel Meeting Minutes Wednesday, 1st of March, 2017 IRIC 105 Conference Room 3:30pm

Moderator: Shea Morrison

Minutes: Ian Tanimoto

- Updates from Teams
 - Stator Design Team
 - Mechanical
 - Cooper's keyway code improved to output more useful information, like torque and heat.
 - Nick ordered tools, and is trying to contact vacuum collar and dome manufacturers.
 - Also more closely examined the raising and lowering mechanism, looking into cooling solutions.
 - Nick acquired bolts for the stator base.
 - Electrical
 - Dr. Hess advised that torque as a function of position is a bad idea, as torque will flatline. Now doing everything by hand, for the sake of understanding.
 - Control Team
 - Controls
 - Completed sensor testing today, deduced that the existing power supply is sufficient to run the sensor.
 - Sensor data can be viewed on a computer as a waveform, and appears to be working correctly.
 - Power supply needs will exceed what currently exists. Kevin Ramus may be able to advise on power supply needs.
 - Next step is to run the code and evaluate the MCU power outputs.
- Updates from Mentors

- Justin
 -
 - David
 -
- Updates from Senior Design
 - Snapshot on 3/7, two teams, stator and controls..
 - Register for expo by 3/10, probably will be done today (3/1).
 - Send Dr. Li the registration form for approval before submission.
- Updates from Tasks Report Meeting
 -
- Next Meeting
 - Moderator: Ian Tanimoto
 - Minutes: Kyle Petersen
- Adjourn

Flywheel Meeting

Minutes

Wednesday, 22nd of March 2017

IRIC 105 Conference Room 3:30pm

Moderator: Kyle Petersen

Minutes: Andrew Jones

- Updates from Teams
 - Stator Design
 - Mechanical
 - Working on polishing EES code.
 - Verifying code with simulations.
 - Still working on thermal fatigue aspects.
 - Electrical
 - Finished simple machine model for Energy.
 - Working on adjusting it to get accurate torque based on rotor angle.
 - Working on math for two pole machine
 - Matt got model working over break
 - Will convert up to four-pole, 24-coil machine
 - Controls
 - Running and analyzing SASB code
 - Currently seems to run, but the I/O pins have a constant output which is unexpected.
 - Reading code to see how the values are determined and why they're not behaving as expected.
 - Want to have the flywheel assembled within two weeks
 - Cold water supply still unavailable.

- Updates from Mentors
 - Justin
 - Thesis defense, early April
 - Gave Cade all of the FEMM models
 - David
 - Absent today
 - Hess
 - Request from journalism major: interview with team members tomorrow (03/23) at 1:30pm in the lab
 - Matt, Nick, Justin, and Brian will attend
 - Dr. Li
 - Still missing team citizenship forms – only has two from stator design and one from controls
- Updates from Senior Design
 - 3/28- Wiki page review session (EP 122)
 - Logbooks due second Friday of April
 - Abstracts for undergrad research symposium due April 3rd
- Updates from Tasks Report Meeting
 -
- Next Meeting
 - Moderator: Andrew Jones
 - Minutes: Matt Phillips
- Adjourn

Flywheel Meeting	Minutes	Wednesday, 5 th of April 2017	IRIC
105 Conference Room	3:30pm		

Moderator: Matt Phillips

Minutes: Cooper Atkinson

- Updates from Teams
 - Stator Design
 - Mechanical
 - Stress verification complete (conditionally)
 - Need to discuss fatigue code with Kyle
 - Abstract submitted, poster started
 - Electrical
 - Working on solving the integral that solves for energy in the air gap
 - Very difficult solve through, looking for other ways
 - Abstract submitted
 - Controls
 - Setting up a second work bench to double code testing capacity
 - Issues with the code involving pin allocation
 - Lack power supply units to properly run tests

- Need +- 15V and 24V power supply units to power coils
 - Need to determine the current requirements
- Updates from Mentors
 - Justin
 - Absent
 - David
 - Absent
 - Dr. Hess
 - Absent
 - Dr. Li
 - 15 minute EXPO presentation will be done by mechanical team
 - Innovation Showcase presentation opportunity for Controls/Electrical teams
 - Not likely to happen due to timeline issues
 - Controls/Electrical teams may have to organize a design review style presentation with mentors to fulfill senior design presentation requirement
 - Undergrad Research Symposium: April 24th
 - Logbooks due Friday, April 14th
- Updates from Senior Design
- Updates from Tasks Report Meeting
- Next Meeting
 - Moderator: Cooper Atkinson
 - Minutes: Nick Bachus
- Adjourn