Team G - Training Plan

After accessing the skills required for completing the Robotic Unicycle, the

following determined skills and backgrounds are required are:

Team Members will learn the spec

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| Topic | Member(s) Tasked | Relevance | Date to be completed |
| Mechanical Modeling | Kevin | taken mechanical modeling classes (Mechanical Engineer) | end fall |
| Real-time Systems | Spencer | Taken computer architecture (Computer Science) | end of fall |
| Non-linear Dynamic Systems | Kevin | Taken controls classes dealing with state-space | end of fall |
| System Modeling in NI software | Ander and Spencer | Experience using NI software | end of fall |
| Sensors, Motors and Parts | Ruffin | Previous experience working with sensors | end of fall |
| System Control in NI software | Ander | Previous experience working with NI software. Taken multiple control classes | end of fall |
| Labview Interfacing | Ruffin | Previous experience working with communications and interfaces. | mid winter |

Priorities in research and training are as follows:

1. System Control in NI software
2. Accelerometer and Gyroscopic Sensing
3. Non-linear dynamic systems
4. Mechanical Modeling
5. System Modeling in NI software
6. Real-time systems
7. User Interface

Individual Contributions:

**Kevin Collins**: I am a mechanical engineering major. All mechanical engineers have to take multiple classes involving modeling a system such as this. I have taken ES-205 Analysis and Design of Engineering Systems where we learned how to model a system using conservation equations and then turn that system into state space form or a transfer function that can be used for control purposes. I will learn different aspects of modeling such as what is vital to control and what is probably not going to have a large impact on the model as a whole. I will also oversee the entire design process so that anything that we do, we will be able to model fairly accurately.

In Germany, i took a non-linear control class that will be useful for modeling this system as well.

I will read different articles on non-linear dynamic systems, especially involving inverted pendulums.

**Spencer Carver**: As a computer science major, one of the more exciting things I get to do on a regular basis is to learn and experiment with different programming languages. Pertaining to this project, I am a Certified LabVIEW Associate Developer (CLAD) along with Ruffin and Ander, and can apply this knowledge of the language directly to the project, as we are working in LabVIEW for National Instruments, the languages developer. On top of this, I have taken several other courses while at Rose (Computer Architecture I being foremost in my mind) which have given me the experience to do extensive top level design and partition the code thoroughly, which helps not only with design, but also with unit testing to ensure everything is working smoothly and correctly. However, I am far from an expert in LabVIEW, and there are many things that the environment can do that I can not even fathom how to work out. Because of this, I will be learning how LabVIEW interfaces with the various real-time sensors that we will be working with, and be researching other real-time related techniques in more detail, such as the timed loop structure (as this is something that is not used as commonly when working strictly on software projects). Since LabVIEW can simulate much of this data, I plan to work on it before we even obtain our actual sensors, in hopes that I can simply ‘plug and chug’ when we do get them.

**Ruffin White**: I am in electrical engineering major with much experience in robotic sensors and communications. Through my involvement with the Rose-Hulman Robotics Team and my internships with Texas Instruments I am well-versed in both LabVIEW programming and sensor interfaces such as SPI, I2C and RS232. This extends into developing custom drivers for LabVIEW with normally unsupported third-party sensors, and embedded system programming and hardwires set up and many debugging skills. I will be researching for appropriate sensors and applicable electrical hardware suitable for the project. This involves finding sensor manufacturers, interfacing those sensors with a real-time control system, and connecting the resulting control signals to the motors and actuators applying the control effort with appropriate feedback. As I am also an RC (remote control) hobbyist, I have much experience in brushless motors and controllers, battery and mobile power management, as well as a good orientation with what and where things available in the hobbyist market that may prove beneficial for the project.

I will also be finding suitable user interfaces to serve as piloting controls and overrides entailing kill switches and other safety mechanisms. Also, thanks to my previous experience with coding and project development, I will be coordinating tools necessary such as subversion control and repositories to help coordinate team contributions with programming and documentation as well as preventing loss of work due to technical failures as the scale of this project and timeline exceeds that of a single semester.

**Ander Solorzano:** I am an electrical engineering student with extensive experience in the robotics field as well as dynamic and linear control systems. I am also a Certified LabVIEW Associate Developer (CLAD) with great experience in LabVIEW Robotics Module Tookit, LabVIEW Vision Assistant tools, and some LabVIEW Real-Time control experience. Most of this experiences come from participating in Rose-Hulman Robotics Team. While working with the team, I got the full breadth of experiencing the design process involving the creation of a robotics platform that competes international IGVC competition hosted by AUVSI. Other experiences relating to control systems include the use of model matching and MATLAB’s sisotool to create several continuous and discrete PID controllers. Additionally, I have successfully created a self-balancing inverted pendulum while attending the ECE 320 Linear Control Systems class. I have also been involved with creating a LabVIEW GUI used for test automation while working at Texas Instruments.

In order to maximize my talents and become a better benefactor to the team, I plan to learn more about LabVIEW Real-Time Software Controls by reading books, researching previous projects, and studying LabVIEW examples that relate to control systems. Furthermore, I am currently taking ECE 420 Discrete Time Control Systems to learn about system that require adaptive controllers due to changing behaviors in the system’s plant. I would also like to learn how to interface with NI’s CRIO hardware to gain an understanding about how to implement a better software algorithm in LabVIEW. In the future, I plan to take my learned skills and apply them to the Robotics Team and future research.