ROBO420 – Testing Plan
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UNIT TEST PLAN: INERTIAL MEASUREMENT UNIT (IMU)	
Background Information	The IMU is the single most critical sensor for our unicycling robot, as it detects the balance of the robot and what direction the robot is falling in. Because of this, testing the IMU is a large priority during the Winter term (as we need to make sure it matches the readings we have in the simulator as well), and will be necessary for the project to continue. The purpose of performing these tests is to determine whether the orientation we planned to mount the IMU in is indeed the best orientation for the sensor, as well as to determine what sort of changes we can process in LabVIEW.
Equipment	**IMU**: The sensor under test **Test frame**: can be as simple as a stick with a mount for the IMU, to the actual frame with a wheel on the bottom. The only requirement for the test frame is that it allows us to independently measure front-back and left-right motion. **LabVIEW VI:** We will construct a LabVIEW VI that allows us to see the outputs of the IMU during each test case, and confirm that the values seen are what we expect.
Experimental Procedure	1) Attach the IMU to the test frame and connect to a computer (running LabVIEW) via USB. 2) Using the MIP Monitor software (came with the IMU), position the test frame such that the IMU is level and fix it in such a way that it can be returned to this position easily between tests (e.g. on a stand or a marked location). 3) Change to LabVIEW and begin running the test VI. Release the test frame such that it falls in the desired direction. Be sure to catch the frame after the desired angle has been displaced (likely around 20 degrees). 4) Stop the LabVIEW VI and observe the accelerometer data and Euler angles (saved to disk for future review as well). 5) Repeat test multiple times for a decent benchmark, then reorient the test frame (but not the IMU) and proceed to perform multiple tests in the second direction of interest.
Criteria for Pass/Fail	**RELIABILITY** – The sensor can function without interruption or error for the duration of a demonstration (~20 minutes) **CONSISTENCY** – When tested as above, the sensor exhibits consistent performance throughout multiple trials (e.g. 3 trials per orientation) **PERFORMANCE** – The sensor feeds back data at the expected rate (compare rate of data in to specified rate for IMU) within a small % difference

SYSTEM TEST PLAN	
Background Information	Once the robot has been assembled and the controls have been programmed onto the cRIO, there still remains much work to be done fine tuning the controls algorithm and making adjustments in order to better optimize the weight balance and performance of the unicycling robot.
Equipment	**Training Wheels:** For early testing, these will be instrumental in eliminating the side-to-side component of balance until we have the accuracy in controls pinned down to the point we would be able to have a reasonable amount of success balancing the robot. **Assembled Robot:** The completed robot according to our current model will be necessary before full system integration tests can be performed, though the design will likely be modified slightly as tests progress to better the performance of the robot. **LabVIEW test VIs**: Similar to the ones used during the unit testing of the IMU, the test Vis for this set of testing will allow us to record the data coming in from our various sensors, and ensure that the data is being handled as expected. **Skirt:** One of the safety precautions that will be in place on the robot is a 'skirt' made to prevent the robot from falling too far if it becomes imbalanced beyond recoverable means. This will allow us to test more thoroughly without fear of breaking the robot.
Experimental Procedure	1) Once completed controls algorithm and robot design have been made, attach training wheels to the robot and hold in home position. 2) Enable robot and release. Observe front-to-back balancing pattern and recorded data and make adjustments until the robot is able to balance within specifications from the scope of work. 3) Remove training wheels and attach skirt to robot. Additionally, use small wooden blocks to hold wheel in place front-to-back, releasing the robot and observing side-to-side balancing. Make adjustments based on observations and recorded data until the robot is able to balance side-to-side as specified in the scope of work. 4) Remove wooden blocks (leave skirt attached) and hold the robot in home position. Enable and release it, observing full balancing or making adjustments until full balancing (front-to-back and side-to-side) is observed.
Criteria for Pass/Fail	**Front-to-Back** – The robot is able to autonomously maintain balance in this direction **Side-to-Side** – The robot is able to autonomously maintain balance in this direction **Complete** – The robot is able to autonomously maintain balance In the front-to-back and side-to-side directions simultaneously