2017-2018 Midwest Space Grant Rocketry Competition:
The Active Roll/Orientation Challenge (with a BONUS Communications Challenge)
Summary of Rules – September 1, 2017
Competition dates:

- *Presentations and safety checks on Saturday, 5/19/18 (late-afternoon into the evening)*
- *Competition flights on Sunday, 5/20/17 (all day – plan to stay for the evening banquet)*
- *Departure date (also weather-delay date) is Monday, 5/21/17*

Part 1 – Required Aspects of the Program

- Modest-range tracking electronics (not just an audio beeper) will be required for ALL rockets. This must include at least one commercial tracking device that may be either a radio "beeper" or else a commercial GPS tracking unit (rugged enough for rocketry) that transmits gps location to a ground station or else directly to the internet. (There is fairly good cell phone service at the North Branch launch site to get on-line with smart phones to check for such data, if posted directly to the internet.) The Tripoli MN rocket club can provide directional receivers for radio beepers operating in the 222MHz to 224MHz range from Communication Specialists < http://www.com-spec.com/rcplane/index.html>.
- The Preliminary Design Report and the Flight Readiness Review will each contain specific questions regarding mentor participation in various phases of the project. These will include questions about the amount of time spent by the mentor on the project, the number of team interactions with the mentor, all design, construction, and safety reviews conducted by the mentor, etc. Mentor engagement may include remote participation using videocons (telecons probably won't suffice, since the mentor will need to "see" what you've built). *Mentors are, in part, responsible for safety. They should, minimally, conduct a review of the design (before construction begins) and a review of the rocket once constructed (before any test flights), with an eye toward safety.* Note: Having a non-student mentor who is at least Level 2 certified, in addition to a faculty adviser, is a requirement for all teams. A Level 2 certified faculty adviser may double as a team mentor, but having an independent mentor is even better. Mentors and faculty advisers are encouraged, but not required, to attend the competition in the spring.
- Specific points will be awarded for "avionics bay reliability." No more comments from judges like "It looks like it was thrown together with parts from the junk drawer." This will entail a careful presentation of the av-bay design in early written reports as well as in-person judging of open av-bays at the competition itself. Judges will be evaluating component organization (including battery orientation), wiring layout, switch positioning, ease of use, and methods of securing components and the sled itself within the av-bay.
- Teams will be required to have at least one flight test on the actual competition motor in advance of the competition, the results of which should be reported upon in the Flight Readiness Review. Points will also be awarded for the thoroughness and analysis of results from additional ground tests of ruggedness such as vibration, high-temperature, shock, ejection charge, etc.
- During the competition two flights will be required using the same motor - either I-class or J-class. Rockets must reach at least 3000 feet above ground level but there is no specific bonus to flying particularly higher than that (though doing so might give the rocket more time to accomplish the competition objectives below). Note that high-thrust motors with short burn times may give more coast time.

Part 2 – Orientation Challenge

- Roll angle (AKA orientation) must be documented with both a non-commercial sensor suite (logging data at least at 10 Hz) plus a down-looking video camera. There will be visible ground markers laid out in the 4 cardinal compass directions (North, South, East, West) near the launch pads.
- The first flight should be with the active roll control system turned on 3 seconds after burnout (to document the natural tendency of the rocket to roll) to try to quash all roll from until apogee – more points will be awarded to rockets that roll the least post-activation.
- Roll/orientation control must be implemented on the rear fins (or at least near the rear of the rocket) – no forward canards with moveable parts. Avoid designs which would cause the rocket to pitch or yaw, rather than roll, if the moving parts don't all work exactly as planned.
- The second flight will be with the active roll control system enabled. After boost the rocket will attempt to roll so as to orient/point the camera side of the rocket (which needs to be opposite the rail-button side of the rocket) following a default series of orientation commands such as "Point North, hold one second, point East hold one second, point North, hold one second, point East, hold one second." The original requested orientation will be 180 degrees off from the direction the camera side points when the rocket is on the rail. Include a bright LED (or a bank of LEDs) in view of the camera and use it to signal to the camera when the rocket is trying to roll CW, when it is trying to roll CCW, and, most importantly, when it is trying to hold its roll orientation (for one second periods).
- Points will be awarded for how effectively the rocket is able to roll to the requested orientations then hold that roll angle, as documented by both the video/LED system and by the on-board sensor suite.

Part 3 – BONUS Communications Challenge – optional & will be judged separately

- Incorporate a 2.4 GHz XBee Pro radio module (50mW to 63mW, one mile range) on the non-commercial sensor suite, to establish uplink/downlink communications prior to and during the flight.
- Points for being able to transmit an alternative series of orientation commands to the rocket (from the spectator area) after the rocket is on the pad but before it is launched. These instructions would replace the default orientation commands mentioned above. This demonstrates the ability to actually "re-program" the rocket's mission by radio link. All commands sent to the rocket, for this step and the last step below, should be preceded by a "secret" two-character "security code" to avoid the rocket from inadvertently accepting commands from a different team. Pairing the XBEE on the rocket and the XBEE on the ground station will help mitigate this possibility as well.
- Points for being able to transmit orientation information (and other information, like gps, acceleration, etc.) to a ground station (in the spectator area) while the rocket is in flight, both during ascent and also during descent. This does NOT necessarily need to be at the 10+ Hz rate of the on-board data logging mentioned above. All transmissions should be preceded by an integer "count" variable, to help distinguish between transmissions (if any) that might legitimately contain exactly the same data.
- Points for being able to get commands to, and replies from, the rocket while in flight. This will be quite basic like "send the following text and have the rocket echo it back" or

“send the following integer and have the rocket calculate its square and send that back.” Rated on the total number of error-free up/down transmissions completed, from ignition to touch-down. Include a security code on every ground transmission, as described above.