**Pitch 1 Outline**

***Requirements***

*Each team will deliver a 5-minute pitch for tutors, examiners, other teams, clients and invited guests. Each pitch will be followed by 5 minutes for questions.*

*Your pitch should cover the following:*

* *What problem are you solving*
* *How are you solving it and how is your approach different*
* *If applicable, a demo of the latest developments*
* *If applicable, ask for the things you need to continue the project*

**Miniature Pitch J**

One nut in space has the same kinetic energy as a car moving at 90km/h!

There is now enough stuff in space that a single collision could start a chain reaction, resulting in catastrophic (**SLIDE**) loss of telecommunication satellites. Tracking space debris enables early warning to operators to relocate satellites from collision paths. At Mount Stromlo a system is being developed by the space environment research centre, of which ANU is a member, which improves on current tracking by an order of magnitude. Our project is to perform systems engineering analysis of an interface critical to the success of the project.

**Main Pitch A**

**SLIDE**

Traditional RADAR tracking is accurate to 100m at best, and barely justifies the fuel cost to move a satellite. Currently operators take the *shut your eyes and pray* approach. Adaptive Optics Space Debris tracking will improve this by at least a factor of 10!!

Adaptive Optics is a process that corrects for distortions in light as it passes through the earth’s turbulent atmosphere and gives much better images. This is the same effect that makes stars twinkle! **SLIDE** See behind me for the difference it makes for on an image of Uranus. This same technique can be applied to lasers propagating back up through the atmosphere to allow LIDAR - light radar - tracking of debris and satellites which is far superior to RADAR tracking.

To apply AO you need a sharp and stable light source to determine how the atmosphere is distorting the light. Initially this was done using a natural guide star, a bright star in the sky close to the object you want to image. However, this restricts the sky coverage achievable and does not work for fast moving objects like satellites or space debris.

To make up for the limitations of natural guide stars, a Laser guide star is required. A laser guide star is created by propagating a laser into the atmosphere. Between 9 and 10 km up there is a sodium layer which will absorb the laser energy and re-emit the light in all directions creating what appears to be a fake star.

**SLIDE J**

There are currently three lasers that can be used for this purpose. One is being built by the company Electro Optics Systems and is a one-off for this project. The only commercially available guide star laser in the world is built by Toptica in Germany, and a new type of semiconductor laser is currently being prototyped and should be just as good as the other lasers, but is significantly smaller and cheaper. For comparison testing and final demonstration of the new semiconductor laser all three need to be interfaced with the 1.8m telescope on Mount Stromlo.

**A**

So far, significant work effort has been dedicated to the development of the laser and AO systems. Interfacing the lasers with the telescope is a bridge that is yet to be crossed. Our group has been tasked with laying the framework of that bridge. This problem has not been addressed before. Nor has this been addressed in other telescope systems as this is a retrofit rather than a bespoke design.

To provide perspective: the EOS laser is this big, weighs roughly a half a ton, has a stack or auxiliary electronics cabinet this high. On the other hand the semiconductor laser is this big, and could be carried by hand.

**SLIDE J**

Our approach it to identify all of the constraints from the four different subsystems shown in the interface tree which considers each of the subsystems separately. Each subsystem is unpacked to physical, electrical, optical and logical interfaces and environmental constraints. Logical interfaces include all forms of control signals and communications. Each subsystem has varying degrees of requirements, constraints and technical complexity. We are currently about halfway through the first phase of this process. The next step will be to identify conflicts between the subsystems and once that is reviewed and approved by the client we will begin working on a conceptual design to resolve the conflicts and allow all lasers to be interfaced simultaneously.

We are currently on schedule and have organised facetime with subject matter experts located on Mt Stromlo, which is the only resource we need to progress at this time.

**Key Questions to preload the other groups**

1. This seems like a vast and complicated interdisciplinary problem. How will you use your systems engineering knowledge to handle this situation and create an appropriate solution?
2. What systems engineering techniques are you using in particular?
   1. How do you approach gathering and coding information from so many different people and sources?
   2. How do you analyse and prioritise all the requirements, and resolve any conflicts that arise?
3. Can you give some examples of subsystems and requirements you have already determined?
4. What do you expect to have achieved by the end of the project/semester? E.g. List of reqs, CAD design, scale prototype.
5. How are you adding value for the client?
6. Why are you aiming to incorporate three lasers, when only one is needed to implement Adaptive Optic techniques?
7. What are each of your roles within the project?
8. What steps are you taking to ensure you’re working as an effective team?
9. What is the most significant issue/risk to project delivery that you expect to face?

**Secondary Questions**

* What it is like working at Mount Stromlo, with so many different companies and organisations? (AITC, EOS, Systems Engineers, Astronomers, Physicists, Technical Staff etc)
* How do you track small and fast moving objects in space? What sort of relativistic effects (ie light travel time) do you have to consider?
* How is adaptive optics using GSL/LGSs used in astronomy? How is that different to using it to track space debris? Why is this so unique?
* How does NASA/ESA currently track space debris? How effective is that?
* What are the fundamental differences between Radar and Lidar?
* Why/how is the ANU involved in this project? What are the ultimate aims and objectives? What sort of funding do you have?
* What types of lasers are there? Different generations?
* How do semiconductor lasers work? How do fibre lasers work?