

## Aircraft Safety System Review

Notes by A. Bouchez, 4/7/06

Presenting: A. Morrisett

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### Introduction and introductions

The purpose of this review is to determine whether our automated safety system (hardware and software) has the appropriate *functionality*. The safety system comprises the ASCAM, IRCAM, and RADAR, though it remains to be determined whether the RADAR will be a permanent part of the system. The performance of each subsystem has not yet been fully explored, and this is a high-priority goal of the April 13-15 engineering run.

### Comments on presentation by Alan

- MT: Ilsky and IRcam computers should be patched regularly. Need to determine responsibility for maintenance.
- RD: Allsky and IRcam are set up as a server so that multiple processes can talk to it. There is currently only one client. This is probably not a problem.
- RD: What is precision of 10Hz toggle by LaserServer process? Run at ~20 Hz. Is circuit designed to be failsafe? Please include electronics design in the final version of the report.
- MT: Which thread saves the images? Processing thread.
- RD: How deep is the stack of images? 10, but only use 3. Could be set lower.
- AB: Slewing dome issue. TCS has a "slew" flag. S/W checks for this, but also compares before and after dome position (over 4s) and shutters if dome has rotated more than 0.2 deg. Need to determine if this will shutter laser during normal tracking.
- RD: Could approach the other way – if star is detected as aircraft due to dome rotation, then shutter. But need to confirm that airplanes don't disappear during rotation.
- KW: Do you guard against satellites? No, we shutter for them.
- RD: There is currently a brightness cutoff for aircraft. Should remove this, since planes could well be brighter than expected? Would cause problems with moon and bright stars.
- KW: Is there any way to deal with changing atmospheric conditions? MT: This is a conservative algorithm at 1-sigma. Can't do much better than that.
- AB: How fast an aircraft is algorithm blind to, due to maximum aggregation size? Size is chosen arbitrarily, but far larger than any observed aircraft.
- RD: Planes blink at 1 Hz. Is this a problem? Could be a conservative approach of going beyond continuity test to blinking planes? Could consider implementing advanced algorithm in avoidance zone only.
- RD: There is an exclusion zone around the moon – does this extend to shuttering the laser? This is a problem. If pixels are excluded, they should not be in the exclusion zone.
- KW: Table Mountain uses cameras for flexibility.
- MT: Probably need a procedure to confirm that we're not pointing at the moon.
- MT: Using trajectory information could solve this problem.
- MT: Laser and moon blooming are same problem.
- KW: Current exclusion zone is set for infinite distance. May need to adjust this based on elevation (low-altitude planes will not fall within circular exclusion zone).
- RD: Alternative approach to laser exclusion would be to try to subtract the beam.
- MT: Should consider not throwing away information outside of exclusion zone. RD: But pilots can swerve. Problem is too difficult to tackle.
- AB: Why are there 2 "end exposures"? Just for safety.

- RD: Why does “start exposure” take 1s? Not certain. How do you know that you’re not exposing for 4s?
- KW: What should angular exclusion zone be, given that you have 7s latency?
- MT: Implement hard-coded minimum exclusion zone size.
- RD: Can we read fewer pixels? This might be worth doing.
- AB: What is rate-limiting process? Normally image acquisition, but DS9 dominates when there are lots of detections.
- MT: Could decide 8.2s for a detection is good enough.
- AB: Long image display time is annoying. Could render natively into an x-window extremely quickly.
- RD: IRCAM cycle time is way out of spec, which was 30 Hz. Where is this time coming from? May be detection algorithm, but did not run faster with thresholding algorithm. Need to determine whether this is OK, for 500ft at 200 Kts.
- AB: May want to rely on radar here? Likely faster.
- AB: IRCAM is threaded, so how fast is camera really going? Maybe in image saving overhead? Need to investigate this.
- MT: Dome filter needs to be taken out of IRCAM software.
- RD: Mask image is not the final image?
- KW: Our IR cam only sensitive out to 3.5 km. Simply don’t detect distant ones. Use trajectory information to discriminate between aircraft and other detections. IR 1, IR2, radar, and predictive avoidance.
- MT: Camera Keith is using is probably far lower noise. Could consider camera upgrade.
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