

The Plan

- Talks
 - Me
 - Biefeld & Lebiere
 - Ball & Gluck
 - Schoelles
 - Bothell
 - Salvucci & Lee
 - Ritter & St. Amant
- General discussion and Q&A with audience

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Flying X-Plane with ACT-R



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Background Project

- NASA grant in 2001 to model pilot taxiing a 737(-ish) plane through O'Hare
 - Were not given the ability to interact with the same simulator code as used in the experiment
 - Did get the database of all the polygons, though
- Pretty much re-implemented everything in Lisp
 - Aircraft braking & acceleration model based on scaled-up version of Salvucci's code
 - Visual environment based on the NASA database
- Important lessons
 - High-fidelity aircraft model critical
 - A pain to do without a jock Lisper around

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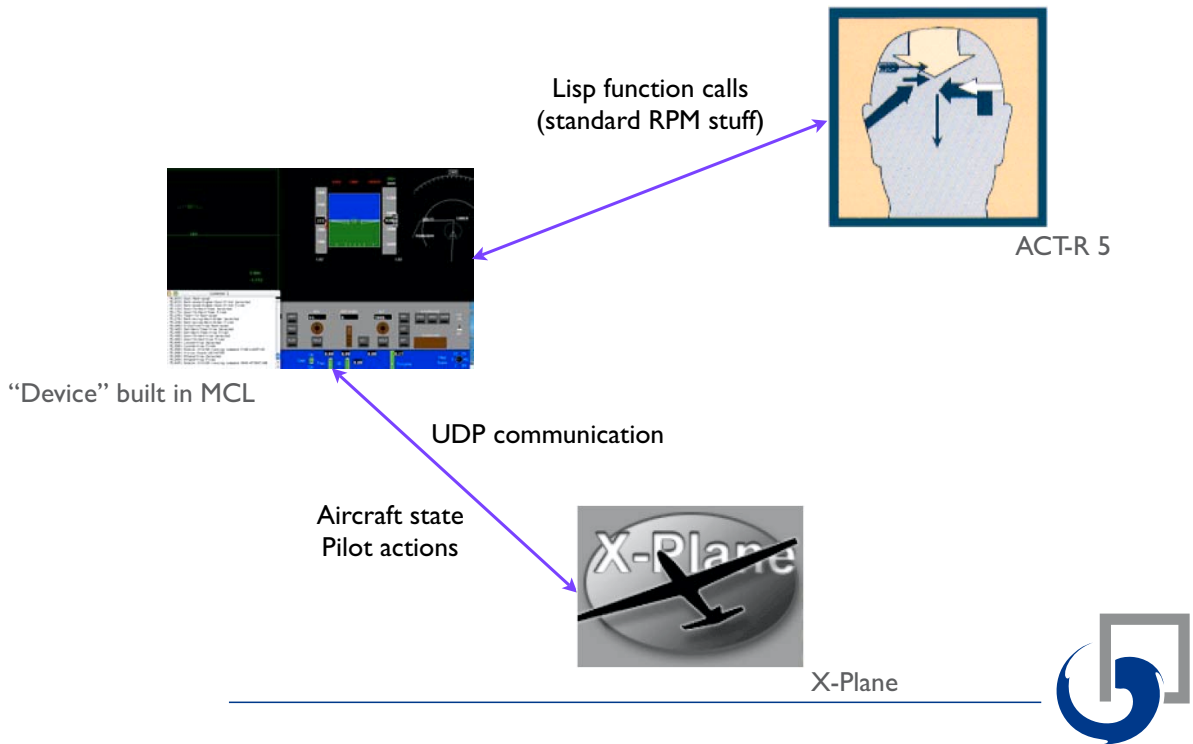
New NASA Work

- Simulate a pilot during final approach and landing
 - Once again, not given experiment code
 - Significantly more complex dynamics than just accelerating and braking
 - + Fidelity to real 757 important to timing
- Our approach
 - Mock up relevant cockpit displays in Lisp
 - Hook up to a separate flight simulator
 - + Must have accurate flight dynamics and an autopilot
 - + Must be able to talk to it in both directions
 - Our choice: X-Plane (www.x-plane.com)
 - + Approved by FAA for real-world pilot training

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The Setup



3904
-1,152

Listener 1

```

sd
gher-Goal-Pitch Selected
gher-Goal-Pitch Fired
-Task Selected
-Task Fired
-Viewed
sxt-Order Selected
sxt-Order Fired
as Retrieved
c-Vias Selected
c-Vias Fired
/ias Selected
/ias Fired
selected
Fired
M running command FIND-LOCATION
LOC142735
selected
Fired
M running command MOVE-ATTENTION
    
```

VIAS LNAV VPATH 3904 3000

260 240 215 200 180

4200 4000 3900 3800 3600

1.02 1.02

GOLET LOBER PHANTOM

164

HDG 44. VERT SPEED 0. ALT 5000.

LNAV VNAV FLCH HOLD V/S HOLD APP

A/P ENGAGE CMDL CMDC CMDR F/D ON OFF

DISENGAGE

Up 0.00 0.00 0.00 0.27

Gear Flap SB Throttle

Map Scale 10 20 5 40 2 80

What is Communicated

- ACT-R productions do their usual thing
 - Look around the screen
 - Commands issued by speech to virtual PNF
- Big issue is the Display \leftrightarrow X-Plane link
 - X-Plane is designed for network “play,” e.g. multiple planes simultaneously in the same airspace
 - X-Plane sends out things like altitude, airspeed, etc. over network interface
 - Display code has routines which render the display based on these values
 - Limited communication from GUI to X-Plane
 - + O.K. for this task, which is mostly monitoring the autopilot

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How Is Communication Achieved

- UDP Network Interface
 - UDP lives below/beneath the TCP/IP socket level, i.e., **very primitive**
 - + No guarantee/verification of packets or anything
 - + Very raw data format
 - However, not uncommon for games to use UDP
- X-Plane side
 - Sends out state information at 20Hz
- GUI side
 - Attempts to pick up network packets at ~15 Hz
 - Translates strings spoken by ACT-R to appropriate commands (limited vocabulary)

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Issues

- Do not try to update the MCL-based display too often!
 - UDP packets sometimes vanish for no apparent reason
 - + Buffer all state and only update the buffer for packets that you actually get
 - + Run display updates from the buffer, not from network
 - It's slow and hurts real-time performance
 - ACT-R doesn't need it anyway
 - + Doesn't access the display all that fast
 - + Cuts down on vision auto-update problems
- X-Plane has its own bugs and problems
 - Documentation, hand-configuration, etc.

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Good News and Work in Progress

- Success
 - Overall works pretty well
 - Nice to be able to run flight sim on separate machine from ACT
 - + Could probably even run it on a <gasp> PC
- In progress: Rendering something like what the pilot can see out the window
 - No information sent by X-Plane about what can be seen out the window
 - Will have to work it out based on location of airplane, which **is** sent
 - Fortunately, real pilots don't do all that much of this

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Time Synchronization

- X-Plane
 - Runs in real time
 - Doesn't have facilities for time synchronization
- Therefore, we run ACT-R in “real time” mode and rely on this to keep everything synchronized
- No problems with this scheme so far
 - Except that it can't run faster than real time
- Acknowledgments
 - Dave Huss at Rice
 - Rei-sung Lin at UIUC

