Notes on NASA telecon (3/19/09)

Flight scenario:

Generic V/TOL scenario.
Times for segments – Need durations for descent and hover phases.
- e.g., 5-7 minutes in descent (need lat. and lon. point for start of descent)
  - Look at Apollo 15 landing site
- 1-2 minutes in hover
  - Consider 0.5ft/sec as acceptable descent rate (?)
  - Duration of hover will depend on transition altitude.

Need to establish hover transition point
Need glideslope - 3 degrees (?)
- 3 degrees may not work, depending on starting lat. and lon. point.
  - (Again, look at Apollo 15 landing site.
  - Peak of Mt. Hadley (4000m), 25km east of landing site.
  - Must clear and then land.

Mike Norman will prepare side terrain profile.

Vehicle dynamics:

Does not model any particular vehicle.
- Vehicle does not fly like aircraft.
  - No atmosphere in simulation; therefore, no drag and lift.
  - Pulling back on nose does not create lift for vehicle.
    - Pitch actually controls deceleration rate.
- For these reasons, must give guidance information in display, if flying manually.

Quadratic deceleration trend
- Constant deceleration throughout descent segment
  - (Mike Norman will define velocity for descent.)
  - e.g., starting at 150-200 kts slowing to standard approach speed (138 kts.)
    - (Units on display should be in English.)

Typical lookdown for helicopter is 15 degrees
- (Harrier typically transitions with nose 30-40 degrees up.)
  - Vehicle will exhibit 0 degrees pitch at transition

Desired modes of auto control.
- Prinzel initially said preferred all manual.
  - If we use integrated display, then pilots can fly whole scenario manually.
  - This would also require guidance cues, which were not present in displays in Y2.
- Norman proposed - Autopilot + hdot.man in descent phase.
  - Use all manual (10-15ft. before hover) at transition point and in hover.
  - Eliminates need for guidance cues in PFD.

Simulation model:

No atmosphere in simulation and no aerodynamic effects on aircraft.
Lunar model - dirty brown terrain.
Blue sky
Need graphical objects for sparse terrain simulation
    Shacks, hanger, palm trees
    Need to develop in open flight file format.
Brownout
    Conditions will include 0 and 100%
        One should lead to landing decision.
        Other should lead to go-around.
        (Decision height should be within hover phase. Decision to go-around should only occur in hover.)
    Need to establish dynamics.
    Begins at what altitude?
    How quickly does it fade?
        Full intensity at ground
        Specify transparency levels across altitudes.

Integrated display:

PFD + ND
    Include inset of terrain beneath vehicle at hover.
    Discussed using same color for tunnel, wireframe and symbology (white)
        Has created confusion for pilots in prior study.
        May want to consider using different color tunnel and wireframe.
            Consider white symbology and green tunnel and wireframce.
    Display will not show a runway, but only landing site/pad.
    No target sink rate shown in PFD (no "green" dot).
        Only show commanded rate (arrow + number + magenta).
        At hover (or below certain speed), sink rate disappears.
            (Need this criteria from helo pilot.)
    Color of FLIR should be gray scale.

Workload and decision making conditions:

Include turbulence in all trials – displays and perceptions of clutter should be tested under flight conditions that exploit SVS and EVS and these are typically high workload conditions.
    Use rotational model of turbulence to create most pronounced visual effect.
Guidance failure cues.
    Incorrect GPS data causes tunnel to drift in horizontal.
        Need to specify one direction of drift for half trials and another for other half.
    When tunnel is not present, magenta line on ND will be lead to wrong landing site.
        (Since ND display only reveals lateral guidance, vertical drift will not be used.)

Experiment design and procedures:

Consider freeze for clutter rating towards end of descent, prior to transition point.
- Also collect clutter ratings at end of hover and landing.
- Control and tasks in each segment vary and may lead to differences in perceived display clutter.

Need to develop detailed pilot briefing/intro to experiment to address potential concerns related to vehicle control and dynamics.
- Kaber, Prinzel and Norman to communicate on this.

Plan to use fractional factorial design…
- Four IVs related to display with 2 levels each.
  - SVS wireframe (on and off)
  - SVS terrain (on and off)
  - EVS (on and off)
  - Tunnel (on and off)
- We will use 2^{4-1} fractional design.
  - Need to determine appropriate resolution of design and necessary number of runs per pilot.
  - In general, design should not include (alias) all interactions involving SVS terrain.
- One IV related to flight conditions with 2 levels
  - Brownout (0 and 100%).

Each pilot will complete 16 trials = 8 display settings * 2 environment settings.

NC State action items:

Subject recruitment
- Agreed on high-time FW captains with glass cockpit experience and no HUD experience.
  - We will not use helo pilots.

IRB approval
- Send exemption letter and updated consent form to Prinzel.

Flight scenario
- Kaufmann and Naylor to draft and send to Norman by 3/27.

Kim
- Develop graphical objects for simulation and send to Arthur by 3/27.

Check-out on simulator
- Tentatively scheduled between 5/15 and 6/1.
- Need security clearance processed for Kim for 6/1-6/19, as soon as possible.