Low Fidelity Flight Simulation in Collegiate Aviation

Kalamazoo, MI – Phoenix, AZ
January 16, 2015
Topics to be Presented

• Low fidelity simulation (LFS) as a concept of flight simulator training efficiency enhancement

• Simulation fidelity in aviation training
  – Conditions of low fidelity simulation (LFS) acceptability in aviation personnel training

• LFS applications tested in the WMU College of Aviation
  – Student pilot peer mentoring
  – Multi-engine and multi-crew training
  – Aviation human factors research

• Issues to consider while putting the LFS concept into aviation college practice

• Recommendations on how the collegiate aviation may benefit from the LFS concept
LFS: An Approach to Training Efficiency

- “Inadequate actions of flight crewmembers continue to cause accidents in the air transportation industry of the 21st Century” (FAA, 2010)
- “Profession-relevant changes in pilots’ personal behavior is a key to 21st Century flight safety” (Kern, 2012)

- Traditional steps of aviation college student pilots’ professional progress (class teaching, flight simulator, aircraft flight) are expensive and cannot be reduced

- If students need more time above FAA set minimum:
  - Costly training brings to Retention problems

LFS provides more flight simulation training time while reducing training cost
Simulation Fidelity: Definition

1. The degree to which a model or simulation reproduces the state and behavior of a real world object or the perception of a real world object, feature, condition, or chosen standard in a measurable or perceivable manner; a measure of the realism of a model or simulation; faithfulness…

2. The methods, metrics, and descriptions of models or simulations used to compare those models or simulations to their real world referents or to other simulations in such terms as accuracy, scope, resolution, level of detail, level of abstraction and repeatability…

(Northam, 2000)
Low Fidelity versus High Fidelity Simulation in Flight Training

• Inexpensive, low-fidelity simulation (LFS) in flight training is acceptable because it can be effective for training in normal flight operations if it is supplemented by a high-quality training program.

• The LFS is especially significant in the beginning of the flight training process when the high-fidelity simulation may produce cognitive overload of the trainee pilot that reduces the training efficiency.

(Stewart et al, 2008)
Components of LFS Trainers in WMU College of Aviation

• Personal Computer
• Microsoft Flight Simulator-X software with add-ons from other software manufacturers
• Displays (4 – 6, including 2 touch screens)
• Flight controls
  – Sidestick or control wheel
  – Rudder pedals
  – Engine control device
• Mounting hardware
Student Pilot Self-Training in Cirrus SR20 Low Fidelity Simulator
Student Pilot Peer Mentoring in Cirrus SR20 LFS

Peer mentoring becomes popular in higher education institutions (UVM, 2011; Lamb and Dana, 2012)

- Student peer mentors help student pilots in self-training on flight exercises briefed by certified flight instructors (CFI) before LFS sessions.

- After every LFS session peer mentors make notes for CFIs on trainee students’ performance during the session.
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
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<th>H</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>LFS Session Date</td>
<td>Time in</td>
<td>Time out</td>
<td>Duration, hrs</td>
<td>Trainee</td>
<td>CFI</td>
<td>Lesson</td>
<td>Exercise</td>
<td>Mentor's notes</td>
</tr>
<tr>
<td>2</td>
<td>6/25/2013</td>
<td>1700</td>
<td>1830</td>
<td>1.5</td>
<td>NK</td>
<td>IM</td>
<td>18</td>
<td>Straight and Level, Holding Altitude throughout a turn,</td>
<td>A trouble keeping everything coordinated.</td>
</tr>
<tr>
<td>3</td>
<td>6/27/2013</td>
<td>1345</td>
<td>1450</td>
<td>1.1</td>
<td>NK</td>
<td>IM</td>
<td>18</td>
<td>Straight and Level, Mtng airspeed + altitude + bank</td>
<td>More confident in the airplane.</td>
</tr>
<tr>
<td>4</td>
<td>6/28/2013</td>
<td>1145</td>
<td>1345</td>
<td>2</td>
<td>NK</td>
<td>IM</td>
<td>18</td>
<td>Mtng airspeed +alt + bank in turns. Climbing turns</td>
<td>While introduced some distractions, improving division of attention skills.</td>
</tr>
<tr>
<td>5</td>
<td>7/2/2013</td>
<td>1345</td>
<td>1515</td>
<td>1.5</td>
<td>NK</td>
<td>IM</td>
<td>18</td>
<td>Mtng airspeed +alt + hdg w/o instr. Turns/Levels</td>
<td>Maintained visual references w/o instruments.</td>
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<tr>
<td>6</td>
<td>7/5/2013</td>
<td>1545</td>
<td>1745</td>
<td>2</td>
<td>NK</td>
<td>IM</td>
<td>18</td>
<td>Mtng straight and level with changing airspeed</td>
<td>Needs more work on division of attention. Overall good improvement.</td>
</tr>
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PA-44 Seminole Low Fidelity Flight Simulator used for Multi-Engine & Multi-Crew Training
LFS Concept Usefulness: Flight Personnel Proficiency Development

• The PC-based LFS helps accelerate development of pilots’ cognitive and professional behavior skills that do not require the simulation high fidelity, such as:
  – Familiarization with aircraft system controls and parameters indication,
  – Memorizing of pre-flight and in-flight action sequences,
  – Development of action flows throughout execution of operational procedures
  – Distribution of attention in visual and instrument flights
  – Development of teamwork and crew resource management skills in multi-crew flight operations

• Peer mentoring in LFS is conducive to creation a pool of potential aviation instructors.
LFS Concept Usefulness: Flight Training Cost Reduction

- Students do not pay for time of self-training in LFS
- LFS helps reduction of students’ training time in FTD and Airplane Flights used to achieve required proficiency
- Student retention rate improves due to increased affordability of flight training

<table>
<thead>
<tr>
<th>Cirrus SR20 aircraft flight training means</th>
<th>One hour training costs, $</th>
</tr>
</thead>
<tbody>
<tr>
<td>High fidelity flight training device</td>
<td>Student: 68.00</td>
</tr>
<tr>
<td>Aircraft flight</td>
<td>Student: 233.00</td>
</tr>
<tr>
<td>PC-based low fidelity simulator</td>
<td>Student: 0.00 CoA: 25.00</td>
</tr>
</tbody>
</table>
LFS Concept Usefulness: Aviation Human Factors Research

• Preliminary study on pilot performance in emergency situations (engine failure) and in pilot / ATC communication error management
  – Researcher: Ms. Fehime Utkan, M.Sc., PhD Candidate, WMU College of Engineering and Applied Sciences, Department of Industrial & Manufacturing Engineering, Human Performance Institute
  – Project advisors: Dr. Tycho Fredericks, Dr. Vladimir Risukhin
Cirrus SR20 Low Fidelity Flight Simulator used for Aviation Human Factors Research
Issues of Putting the LFS Concept into Aviation College Practice

• Trainee students’ time scheduling:
  – LFS training is added to academic classed, standard flight simulator sessions and airplane flights

• Coordination between:
  – CFIs and student mentors in peer mentoring
  – academic faculty and CFIs in multi-crew training and in research activities

• LFS stations operation requirements:
  – Space for LFS location
  – Maintenance support from IT personnel
Conclusion and Recommendation

- LFS usefulness has been demonstrated in:
  - Student pilot peer mentoring
    - Faster development of professionally important skills
    - Reduction of flight training cost
  - Multi-crew flight operation environment
    - Teamwork
    - CRM
  - Research of pilot performance
    - Radio communication
    - Stressful situations

- In addition to LFS applications described in this presentation, the collegiate aviation may benefit from this concept in:
  - Including LFS as a supplementary component of aviation student training programs other than flight operations (aircraft maintenance, air traffic control)
  - Accumulation of quantitative data on trainee students’ performance in various flight tasks to improve training
References

Thank You!

Questions?

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