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NASA FutureFlight Central
Third Quarterly Newsletter

July 2001

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The LAX Story Part III: How Real Did It Get?

Representing one of the world's most complex, human interactive simulations of air traffic control operations, NASA's simulation of LAX included over 23 human participants interacting with over 120 traffic operations per hour.

This article briefly describes how NASA met the first goal of the study, namely, to recreate a realistic operating environment for LAX ATCs (Air Traffic Controllers), so that their actions, radio transmissions, team coordination, etc. were as close as possible to what they experience in their real-world 277-foot tower.

Tower Cab: Physical Configuration & Out-the-Window Views

One of the fundamental criteria for ATC realism, although technically difficult to achieve, is to provide the ATC with a visual field and hands-on physical cab environment that resembles their own actual tower environment.

For the LAX study, the tower cab at FutureFlight Central was physically configured to match that of LAX's tower cab as closely as possible. Further, the visual scene was adjusted such that views from different ATC positions (e.g. local1, ground 1) were matched to the corresponding positions and views in the real LAX tower.

Compare Figures A and B showing views of the Local-1/South Side controller position at the real LAX and at FutureFlight. While not identical, most people agree that the two photos are quite similar.

A) LAX B) FFC LAX

Airport Traffic Statistics: Is It As Busy as LAX?

As much as the real and virtual airports may appear the similar, it is equally important that the nature and degree of the aircraft movements in the air and on the ground approximate those of the simulated airport. For the LAX study, in order to replicate the operational behavior of the airport, FutureFlight staff examined several measures of airport statistics, including peak and average arrival/departure rates, outbound taxi times, and runway occupancy times.

Figure 1 shows the average arrival and departure rates operating at NASA's virtual LAX (vLAX) compared to measured peak departure rates at the real world's LAX. The most prominent feature is that LAX controllers were moving quite a volume of traffic, comparable and in some cases, exceeding the real LAX.

It is important to note that traffic was purposefully elevated over normal levels in order to press the workload of the ATCs. The rationale was that, as primarily a safety (not capacity) study, the LAX simulation needed to measure ATC performance under high workloads. As many of the factors inherent to the real world ATC workload were not simulated (e.g. no national ground delay programs, sparse ground vehicle traffic, no breakdowns), workload level was instead increased by artificially inducing higher arrival and departure rates.

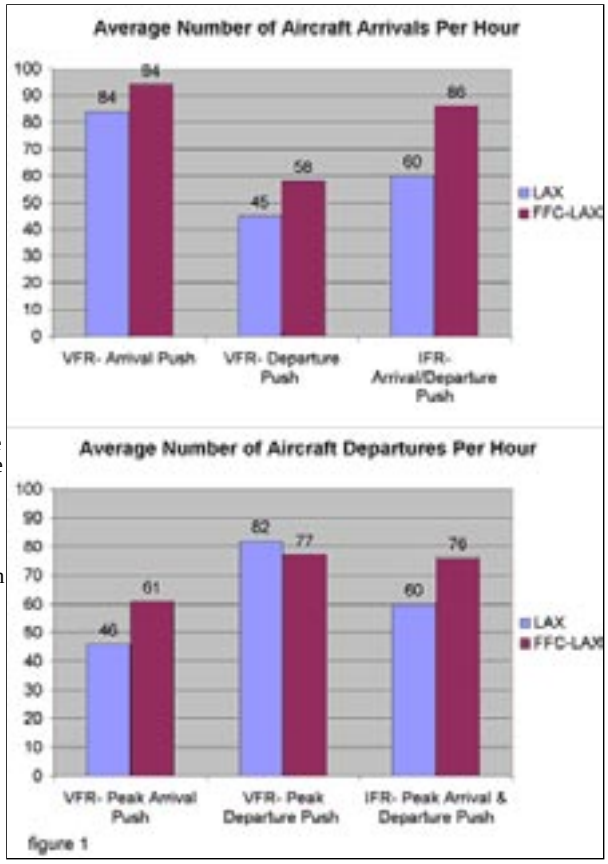


figure 1

Figure 2 shows a comparison of average aircraft taxi out times at LAX versus FutureFlight virtual LAX.

Notice the envelope of taxi times for LAX and vLAX are similar: For the North sides of both LAX and vLAX, aircraft on average take nearly two to three times as long to taxi to the opposite side of the airport. In contrast, for the South sides of both LAX and NASA's airport, aircraft originating in the South gates take just as long to reach a South runway as the farther distance North runways (due to the profound South-side congestion). Note that 82% of out-the-gate traffic at LAX originates at the North and South gates.

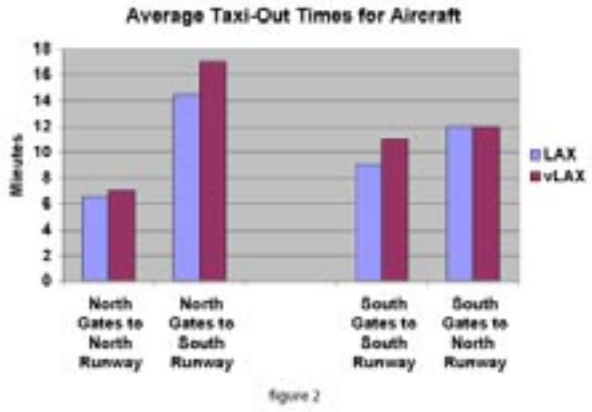


figure 2

ATC Workload Comparisons

ATC workload is one of the most important measures to assess as it reflects not only whether the ATCs are

working as hard as they do at LAX, but wh
approximates that at LAX. Figure 3 shows
coordination with ground (for locals) appro

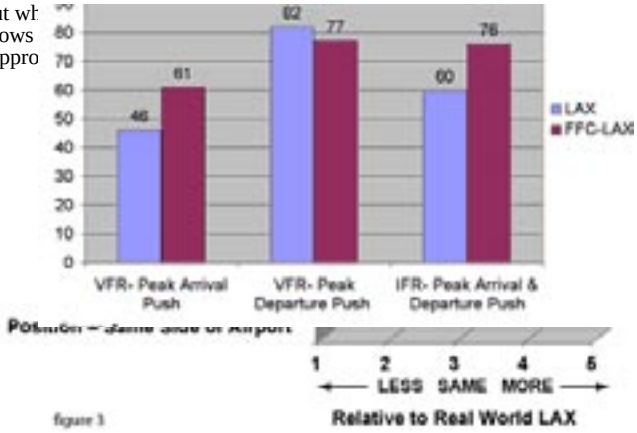


figure 3

ATC Subjective Judgments of Realism of NASA's Virtual LAX

One of the most compelling findings of NASA validation testing is that LAX ATCs participating in the simulation found that the NASA simulation was highly realistic in terms of LAX traffic complexity (Figure 4) Given that LAX is one of the busiest airports in the world, this result is non-trivial.

Complementing these subjective ratings from ATCs, the comments from the participants suggest that the, even with its "maiden voyage", FutureFlight Central -if only momentarily-deceived controllers:

> "I actually had a heightened state of awareness that I normally experience working live traffic." (Anonymous LAX controller)
>
> "Even though aircraft movement might be a little different, the overall effect is very realistic. There is a definite frustration factor --- just like the real thing." (Anonymous LAX ATC)

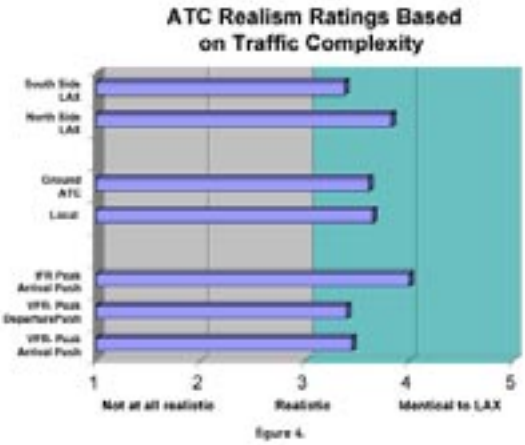


figure 4.

As Story 4 (Air Traffic Controllers and the Mission to Mars) in this newsletter describes, preliminary physiological measures suggest that controllers experienced high stress levels in the FutureFlight simulator.

Summary

Frank Sweeney, Support Manager of LAX Tower, put it, "The NASA simulation was remarkably similar to LAX in real life. While by no means identical or as complex as the LAX airport environment with all its distractions, the NASA simulation did let us judge what would NOT work at LAX. Simply put: If we could not get it to work in the simplified NASA version of LAX airport, then it was clearly not going to work at real LAX. This saved the airport a lot of time (and money) in eliminating those untenable procedures and/or options." In our next issue, we will give an overview of the key findings from the LAX study of mitigating measures for runway incursions.

Waiting in the Wings: ATC Situational Awareness as a Factor in Safe & Efficient Ground Operations

The FAA Runway Safety Office, a key participant in FutureFlight's study of runway incursion mitigation at LAX, and aviation research experts from NASA Ames Research Center, are collaborating on a new study at NASA FutureFlight Central.

The next project will focus on a new topic: ATC Situational Awareness factors relevant to surface operations. Drs. Immanuel Barshi and Dave Foyle of NASA Ames Research Center, both of whom have extensive experience in aviation human factors research and surface-related ATC research, are leading the study. For further information, please contact the investigators at dfoyle@mail.arc.nasa.gov or ibarshi@mail.arc.nasa.gov.

Reader Poll: What do You Think About Virtual Training for LAHSO?

On occasion, the FutureFlight Central team seeks reader feedback about what types of simulations you believe would be most useful to the airport community. This issue's reader poll explores Land and Hold Short Operations (LAHSO).

According to the Aeronautical Information Manual (AIM), LAHSO are procedures for simultaneous takeoffs and landings and/or simultaneous landings when a landing aircraft is able and is instructed by the controller to hold-short of the intersecting runway/taxiway or designated hold-short point.

In 1999, in answer to safety concerns, the FAA revised the LAHSO required procedures (including usage and surface equipment for LAHSO lighting). As a result of these changes, several major US airports lost

availability of LAHSO, thereby experiencing capacity losses.

For instance, the January 2001 FAA Monthly Summary of ATC Delays in the National Air Space (you need Acrobat Reader to view this file) reported there were nearly 2,654 delays related to lack of availability of LAHSO or 10% of the month's total 27,979 delays.

As a specific example, the FAA Benchmarking report published in April pointed out: "The loss of LAHSO in 1999 at ORD resulted in a reduction of 36 to 40 arrivals and departures per hour in one of the most commonly used runway configurations."

The benchmarking report noted that several airports are reinstituting LAHSO procedures.

Suggested Simulation: Let your controllers "test drive" LAHSO under different traffic load conditions, at different runways and intersections in the safety of a virtual airport.

FFC's airport modeling also allows evaluating the pilot side of the LAHSO equation: FFC's interface enables the controllers in FFC to share the same air space with simulator pilots. Thus two pilots sitting in two separate cockpit simulators (for instance one representing an aircraft taking off on Runway X; the other pilot commanding an aircraft cleared to land on Runway Y) could be directed by ATCs in the FutureFlight facility using a LAHSO procedure.

We'd like to know our airport and airline readers' thoughts on this important topic. If you have a strong opinion on LAHSO, please click to get to our simple four-question survey form.

Air Traffic Controllers and the Mission to Mars

(Contributed by Dr. Pat Cowings, NASA Ames Research Center)
Did you know that NASA has projected the first manned mission to MARS can occur as early as January 20, 2013? We have the technology to boost the vehicles, provide life support, and enable exploration. There's just one catch. Very little is known about how well the "human element" will stand up to the rigorous demands of that 18 month mission. Several international teams of scientists have devoted themselves to the investigation of potential biomedical and behavioral problems those space explorers might encounter, and to the development of solutions to those problems.

So what does that have to do with air traffic controllers?

The Psychophysiological Research Laboratory at NASA's Ames Research Center is developing an "index of functional state," defined as that condition where health, safety and performance are at peak levels. This index is based on simultaneous measures of physiological responses, performance skills, and self-reports of subjects.

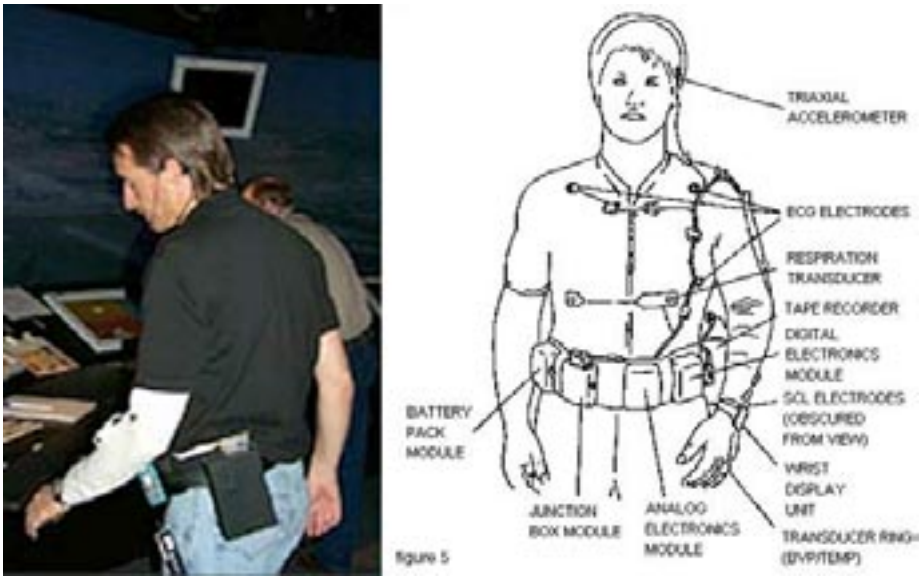
The lab has been looking for operational environments that might be considered Earth-based analogs for a space crew during long duration missions to try to determine those factors associated with impaired or optimal operational efficiency. We considered air traffic controllers (ATCs) to be a very good model for space crews, as their jobs involve such elements as "sustained vigilance" and "critical decision making tasks," that have very real consequences to the lives of air passengers and crew. It is also clear that ATCs perform their jobs very well, despite working in a "high stress" environment. It is certainly known that there are operational conditions in which physiological responses to stress are necessary rather than considered an "aberrant response."

How do they do it? What's happening to the physiology of these people as they work through difficult shifts and rotating work schedules? What can we learn from ATCs that could benefit long duration space crews?

Recently, a feasibility study was performed at NASA FutureFlight Central. During this study four ATCs normally stationed at Los Angeles International Airport, were working in the FFC to evaluate new procedures for their South-side operation that would address the airport's susceptibility to runway incursion. As seen in Figure 5, controllers wore a special ambulatory monitoring system (space underwear) designed to measure astronaut physiology in space.

The feasibility study verified that LAX ATCs could perform their work, unimpeded by the garment and that stress levels could be adequately measured. Collaborative research results from such "real world" analog environments would be invaluable to both the FAA and NASA.

If you're interested in learning more or participating as an ATC subject, please contact Dr. Pat Cowings.



Techno Innovations @ FFC:
FAA Noise Analysis Software to Enhance FutureFlight Capabilities

Noise analysis profiling for airports is one of the most requested features by visitors to NASA FutureFlight Central.

Via funding through NASA's Quiet Aircraft Technology (QAT) Program, FutureFlight Central will soon integrate the FAA's Integrated Noise Model (INM), a standard tool for assessing aircraft noise in the vicinity of airports and the most widely used model of its kind in the world. The model utilizes flight track information, aircraft fleet mix, standard and user defined aircraft profiles and terrain as inputs. The INM model produces noise exposure contours that are used for land use compatibility maps.

As part of the QAT effort, NASA hopes researchers will be better able to improve and refine the model. FutureFlight will ultimately host a "noise office" prototype display, which could allow controllers to redirect air traffic to mitigate or more evenly distribute community noise.

Noise modeling capability at FFC will be available to customers in Fall, 2001.

Upcoming Events and Trade Shows

NASA FutureFlight Central will be participating in the following events:

August 27-30, 2001:
International Aviation Training Symposium (IATS) for the FAA Academy,
Myriad Convention Center,
Oklahoma City, Oklahoma

September 11-13, 2001:
SAE International 2001 Advances in Aviation Safety Conference
Seattle, Washington

September 25-26, 2001:
National Air Traffic Controllers Association (NATCA)
Communicating for Safety Conference
Denver, Colorado

October 21-24, 2001:
The FAA Conference for the Federal Manager's Association
The Luxor Hotel & Casino
Las Vegas, Nevada

If you are attending any of these events and would like to a book an appointment in advance to speak with us, please call Nancy Tucker at 650.604.5575 or send an email to: ntucker@mail.arc.nasa.gov.

Thinking of Doing Business with FutureFlight Central?

Contact **Nancy Dorighi,** FutureFlight Central Manager, Nancy.S.Dorighi@nasa.gov or phone **650.604.3258** for more information and to explore what we can do for your airport or airline needs.

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