Target Generation Facility (TGF)
ACB-860 Simulation Group

Project Summary

Fiscal Year 2009

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TGF Project Summary FY 2009

Executive Summary

The Target Generation Facility (TGF) completed another successful simulation year. All simulations were provided on-time and met or exceeded customer expectations. In addition to completing these simulations many enhancements were added to the Target Generation Facility's aircraft dynamics engine, simulation pilot workstation and hardware infrastructure.

This fiscal year could be thought of as the year of En-Route Automation Modernization (ERAM) Operational Testing & Evaluation (OT&E). TGF supported the program the full 52 weeks. TGF is currently supporting regression test preparation and Discrepancy Report (DR) Validation. We expect to continue support into FY10.

Full Tower Visual Simulation in the Human Factors Laboratory (HFL) was achieved. TGF's new Visual simulation capability got a full workout supporting Human in the loop studies using this new capability. (see Section 1.2)

Looking forward to FY10, TGF is committed to continued support of ERAM Test activities. Research Development and Human Factors Laboratory (RDHFL) support includes support for new Data Communications (aka Data Link) experiments and Demonstrations scheduled for the winter and spring. We look forward to assisting in the development of the Technical Center NIEC laboratory with the expectation of Initial Operational Capability (IOC) in FY10. Full Tower Visual Simulation in the NIEC laboratory is anticipated, with the development of a Dallas/Fort Worth Tower simulation in support of the Staffed NextGen Tower program.

Section 1 – Simulation Projects Supported

This section summarizes the simulation efforts supported by the Target Generation Facility during the fiscal year.

1.1 ERAM Operational Testing – Regression Testing – DR Closeout activities

Simulation Dates: October 2008 – September 2009

Program Office: ERAM

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Simulation Summary

New developments in fiscal year 2009 include the development of an AOI ZLC/ZSE scenario to focus on the AOI functionality in a less-complex airspace (instead of ZDC). Also, FS9 was developed specifically to test circular Military routes. During this fiscal year we also developed long running (8+ hour) extended versions of FS10 and FS3. We supported Formal OT Regression for ERAM Release 1, DR Closeout activities, numerous formal operational evaluations for ERAM release 1 and 2 systems, and upgraded the flight samples in correlation with a chart change update for ZDC. We continue to accommodate an intensive ERAM system release schedule and completed over 70 uplevels of the SGET scenario data, while providing reliable year round support for ERAM system testing.

1.2 Tower Data Communications (TDCS2)

Simulation Dates: October-December 2009

Program Office: ATO-P Research and Technology Development Office AJP-6

Contacts:

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Simulation Summary

This study was conducted to study the performance of data communications in the tower environment.

The Genera Tower based on Boston-Logan Intl Airport is being modeled for this simulation.

1.3 FEWS III

Simulation Dates: Oct 15,20, Nov 12, 17, Dec 2, 8, 2008
Jan 6, 12, 27, Feb 2, 10, 17 2009

Program Office: ATO-P, ATO-W and ATO-E
AJP-611 Human Factors R, E&D

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Simulation Summary

The FEWS III simulation investigated new and emerging concepts based on NextGen plans to increase airspace capacity. The concepts included the increased use of Area Navigation (RNAV) routes and the delegation of self-spacing to the flight deck. We also included an aircraft grouping procedure to enable two or more aircraft to be controlled as a single unit, similar to the way that controllers manage military aircraft in formation flight. These concepts would presumably enable the aircraft to require less controller intervention and reduce controller workload.

We included modifications to the FEWS controller workstation to support use of the RNAV, self-spacing, and aircraft grouping procedures. We used a high altitude generic airspace sector (ZGN08) and included very high (2 to 3 times current) traffic levels in which 70% of the aircraft were equipped with Data Communications. We assumed Automatic Dependent Surveillance-Broadcast (ADS-B) capabilities and used three-mile lateral separation standards in all conditions.

The TGF staff implemented the necessary aircraft capabilities to enable the advanced concepts. They spent considerable time and effort developing the required functionality and working with us to troubleshoot and refine the concepts. We required two types of RNAV conformance: one in which aircraft conformed to a route laterally, and another in which the aircraft conformed to a route both laterally and vertically. For aircraft self-spacing, we required that an individual aircraft follow a designated lead and carry out everything the lead aircraft did at the same point at which the lead did (e.g., turn to a heading). For aircraft grouping, we required that two or more aircraft fly as a single unit relative to one another with each aircraft in the group maneuvering simultaneously when the controller issued an instruction to the group. The TGF staff enabled the required functionality so that we were able to evaluate the concepts with en route controllers.

1.4 Separation Management

Simulation Dates: December 1- 5 2008
September 9 -24 2009

Program Office: Technical Operations
ATO-E
Separation Management

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Simulation Summary

The Separation Management (SepMan) Human Factors team built an initial prototype of enhancements on an ERAM emulation platform. The SepMan team condcuted a demonstration of SepMan capabilities to refine requirements. SepMan capabilities included wake turbulence separation indication and alerting; distance reference indication based on aircraft type; support for Unmanned Aerial Systems (UASs); support for conflict probe and tactical conflict alerting in 3-nm separation minimum airspace; conflict probe detection and trial planning on the Radar and Data position displays; and off-route detection and alerting. The SepMan team conducted a demonstation of the prototype capabilities to refine prototype requirements for the HITL experiments.
The SepMan team built a simulation environment that could support baseline conditions using current separation requirements as well an environment that required variable separation standards in the same airspace without automation support and an environment with varable separation standards but with support of new automation functions. The SepMan team conducted a HITL with 12 certified CPCs working in team of 2 controllers. By rotating controllers across teams, the SepMan team was able to create four unique teams out of each group of four controllers. Each controller team worked traffic under a baseline, a variable separation without automation, and a variable separation with tools condition.

The TGF team provided support for the use of up to two experimental control stations (ECOs) simultaneously and six simulation pilot positions. The TGF supported the Human Factors Team's Generic Center (ZGN) airspace concept and used a low altitude sector. Traffic levels supported by TGF reach 150% of curent traffic levels for the low altitude sector or approximately 18 aircraft.

1.5 Data Communications

Simulation Dates: December 2,9,10,11 2008

Program Office: ATO-P Research and Technology Development Office AJP-6
En route Data Communications Segment 1 and 2

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Simulation Summary

The En Route Data Communications (ERDC) Human Factors team built an initial prototype of enhancements on an En Route Automation Modernization (ERAM) emulation platform. The ERDC team modified the Target Generation Facility (TGF) and the Distributed Environment for SImulation, Rapid Engineering, and Experimentation (DESIREE) to accept and process a subset of the full RTCA Special Committee 214 (SC214) message set. ERDC messages included transfer of communications, altitude, speed, heading, route, and crossing restriction clearances. The ERDC team conducted a demonstration of prototype ERDC capabilities to refine prototype requirements for the Human-In-The-Loop (HITL) experiment. Four subject matter experts participated in the evaluation of the prototype. The ERDC team further refined the requirements and created a prototype for the HITL.

The ERDC team built an simulation environment that could modify equipage level, human machine interface, flight management system (FMS) integration, data communication failures, technical delay times, and level of service. The simulation environment also accommodated the execution of a part-task environment that investigated the effect of traffic levels and voice-only vs. data communications-only scenarios on cognitive workload. The ERDC team conducted a HITL with 28 certified professional controllers (CPCs) working in teams of 2 controllers. Each controller team worked simulated traffic under 12 different conditions. To determine the impact of equipage level, the CPCs worked traffic under voice only, 10%, 50%, an 100% equipage conditions. The ERDC team evaluated the impact of different human machine interface

implementations by having the CPCs use designs that included keyboard-, template-, or graphical interaction based data entry or a combination of these three entry methods. Some integrated flight decks enable pilots to automatically load data communication messages into the FMS. To assess the impact of FMS integration, the ERDC team modified the simulation pilot response time to be 30% longer when no integration was available. A subset of the CPCs worked under different levels of FMS integration during the simulations. The simulation environment supported data communication failures of individual aircraft, data communication ground stations resulting in partial airspace loss of coverage, and full data communications system failures. All CPCs experienced failures of individual aircraft, and two subsets of the CPCs experienced partial or full data communication system failure respectively. The ERDC team also trained a subset of the CPCs on procedures to provide Best Equipped Best Served (BEBS) services. Under BEBS services, the CPCs attempted to provide prioritized services to aircraft that had data communications equipage.

The part task experiment consisted of six 10-minute scenarios at three traffic levels with voice-only or data communications-only. Twenty-four of the participants worked simulated traffic staffing the sector with a single radar controller.
The ERDC team has completed data collection. During the simulations, the ERDC team collected data on controller interactions with the system, system variables, voice communications, video, eye movements, functional near infrared assessment of oxygenation of the brain, post scenario questionnaires, and over-the-shoulder ratings. Data reduction analysis is in progress. Initial results will be available during the first quarter of FY10.

The TGF team provided support for the use of up to four experimental control stations (ECOs) simultaneously and six simulation pilot positions. The TGF team enhanced its capabilities to support new simulation pilot data entry either through data communications or manual entry. Modification to the simulation pilot stations enabled simulation pilots to monitor the progress of data communication messages, and respond to them interactively. The TGF supported the Human Factors Team's Generic Center (ZGN) airspace concept and used a high altitude sector. Traffic levels supported by TGF reached 150% of current traffic levels or 24 aircraft on the frequency at any point in time.

1.6 Future Terminal Work Station (FTWS1)

Simulation Dates: June 2009

Program Office: AT System Concept Development Group
AJP-66
DataComm Segment 2

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Simulation Summary

In 2009, engineering research psychologists and simulation support personnel developed and executed two human-in-the-loop simulations as part of the Future Terminal Workstation (FTWS) project. FTWS is an FAA-sponsored RE&D project examining potential future operational concepts, procedures, and technologies for the approach control domain. The first simulation, FTWS-1, was completed in June 2009 and examined several new functions and user interfaces for the approach control environment, including new communication, navigation, surveillance, and decision support tools. These tools were developed using the Distributed Environment for Simulation Rapid Engineering and Experimentation (DESIREE). Some of these tools had been developed and tested separately, but FTWS-1 was the first simulation to integrate all of these onto a single controller workstation. FTWS-1 used scenarios created using the Target Generation Facility (TGF), which provided realistic aircraft behavior and simulation pilots. The scenarios included traffic volumes based on 2008 levels and projections for 2020 and 2025. The scenarios also included different mixes of aircraft equipage, including Area Navigation (RNAV), Automatic Dependent Surveillance Broadcast (ADS-B) and Data Communication (Data Comm) capabilities. The FTWS-1 simulation was conducted using the Genera TRACON airspace, which emulates a large four-runway airport with three nearby regional airports. Genera TRACON allows researchers to develop realistic scenarios according to research requirements rather the constraints of actual airspace. Genera TRACON also allows researchers to recruit a large number of controller-participants from multiple sites while minimizing staffing impact on any single facility.

1.7 Automated Terminal Proximity Alert (ATPA)

Simulation Dates: September 1 – 4 2009

Program Office: Automated Terminal Proximity Alert

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Simulation Summary:

Automated Terminal Proximity Alert was a Terminal simulation of DFW's 17L, 17C and 18R final approach course. The purpose of the simulation was to verify and validate the optimal look-ahead times (22 seconds for a yellow indicator, and 45 seconds for a red indicator) for the proximity alert. The simulation consisted of 3 monitor problems where no vectoring was required and 4 vector problems. TGF drove the Common ARTS system.

1.8 ADSB

Simulation Date: June 2009

Program Office:
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Simulation Summary

This simulation was a proof of concept of our abilities to display curved (RNAV) approaches and to translate the location of an aircraft flying locally to appear as if it were flying in an EWR simulation among other simulated targets. The position of the aircraft was provided by ADSB equipment onboard the Technical Center's test aircraft, flying approaches to the local airport (ACY). This position was processed and displayed on a map of EWR in the TGF PVD lab. This technology allows the development and realistic test of new curved approaches into EWR without having to disrupt traffic at EWR.

1.9 NextGen Integration and Evaluation Capability (NIEC)

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Project Summery

TGF participated in the requirements analysis, laboratory design and implementations. The NIEC development started this year and is expected to be fully operational in FY10.

1.10 Staffed NextGen Tower

Program Office:

Name: AT System Concept Development
Program Name: Staffed NextGen Towers (SNT)

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Simulation Summery

The key goal of the HITL simulation is the identification of visual-perceptual elements used in controlling air traffic and the best strategies and tools to respond to the lack of them in both nominal and non-nominal situations. The information obtained from this study will lead to the generation of information display requirements.

Integration of the Tower Information Display (TIDS) from MIT Lincoln Labs for the SNT conditions

Scenario Development 9/9/09 – 12/10/09

Simulation in Spring of 2010.

Section 2 – Technical Summary

This section summarizes the technical achievements of the TGF during the fiscal year.

2.1 Ground Simulation Capabilities

TGF continued to develop it's Ground simulation capabilities. We now have a complete Ground Simulation Capability that is in experimental use at the RDHFL.

2.2 Visual Simulation

TGF received funding for the development of Out The Window (OTW) views" for Tower simulations. Significant progress has been made in the simulation infrastructure. Target Initial Operating Capability (IOC) has been achieved and the RDHFL has run simulations using the capability. A nine (9) Channel 270 degree system in the RDHFL and a six (6) channel 180 degree system for the NextGen Laboratory are planned.

2.3 NIEC Laboratory

TGF was selected as the Air Traffic Simulator for the Technical Center's NIEC laboratory enhancement effort. Laboratory requirements are being purchased and installed. TGF participated in the requirements analysis, planning , purchase and installation of the NIEC laboratory facilities.

2.3 Network Infrastructure

TGF participated in the design/purchase and configuration of the NIEC laboratory networking infrastructure.

2.4 Computing Resources

TGF has installed a technical refresh for our SimPilot positions, and consoles. Wrightline consoles were installed in a two phase plan. Currently our "standard workstation" is running Fedora 10, has 2GB of memory, Intel dual/quad core I7 processors at about 2.4 Ghz. High rez dual link 30 inch displays are available to all developers. The tech refresh has enabled OpenGL capabilities on our workstations and SimPilot stations.

Image generators (IG) and Displays (73 in DLP) hardware have been procured for the OTW system. Prototypes are up and running for use in the NIEC..

Back end infrastructure remains Sun based with 2 terabytes of NFS storage provided by the NAS1/NAS2 Network attached storage appliance, but a new Sun 22 terabyte array has been procured. Our current software platform is the latest version of Sun Storagetech EBS version 7.4, which is the Sun branded version of EMC (formerly Legato) Networker software. Our client availability capabilities to include not only Solaris sparc based computers but also Solaris x86, Solaris amd64 and RedHat Linux machines. Our backup server is a Sun X4200 M2 server and the tape drives in our Spectralogic 10,000 tape library are Sony AIT-52.**5** TGF Aircraft Dynamics

2.6 Aviation SimNet

TGF has become a primary test center for Aviation SimNet. TGF is fully AviationSimNet compliant, with only the Voice interface still remaining. TGF's Aviation SimNet capabilities include the installation of the AviationSimNet SimCenter Servers, to allow the TechCenter to host AviationSimNet simulations. This capability is being used to interface the NIEC Cockpit simulator and GA predator simulators into the simulation infrastructure.

TGF Acronyms and Abbreviations

ADAR	ARTS Data Acquisition & Router
AGW	ARTS GateWay
ARTS	Automated Radar Terminal System
ATCT	Air Traffic Control Tower
CAS	Controller Awareness Study
CTAS	Center TRACON Automation System
CHI	Computer Human Interface
CPDLS	Controller Pilot Data Link Communications
DFS	Deutsche Flugsicherung (German Simulation)
DIS	Distributed Interactive Simulation
DRVSM	Domestic Reduced Vertical Separation Minimum
DSR	Display System Replacement
EDC	Early Display Configuration
ETVS	Enhanced Terminal Voice Switch
FAST	Final Approach Spacing Tool
FFP	Free Flight Phase
FS1, 2/2+	Full Service 1, 2/2+
GAO	Government Accounting Office
GOERS	GPS Outage En route Simulation
GPS	Global Positioning System
HAD	High Altitude Demonstration
HAT	High Altitude Test
HFL	Human Factors Laboratory
HLA	High Level Architecture
IIF	Integration and Interoperability Facility
LAAEP	LA Arrival Enhancement Project
McTMA	Multi-Center Traffic Management Advisor
NAS	National Airspace System
NATCA	National Air Traffic Controllers Association

PARR	Problem Analysis Resolution and Ranking
PAS	Pseudo Aircraft System
PDU	Protocol Data Units
PTR	Program Trouble Reports
RDHFL	Research Development and Human Factors Laboratory
RNAV	Area Navigation
RVSM	Reduced Vertical Separation Minimum
STARS	Stand Alone Terminal ARTS Replacement System
TATCA	Terminal Air Traffic Control Automation
TFM	Traffic Flow Management
TGF	Target Generation Facility
TMA	Traffic Management Advisor
TRACON	Terminal Radar Approach CONtrol
URET	User Request Evaluation Tool
WJHTC	William J. Hughes Technical Center
XPVD	X-windows Planned View Display

TGF Airports and Centers

ADW	Andrews Air Force Base
DCA	Ronald Reagan International Airport
DFW	Dallas Fort-Worth International Airport
EWR	Newark International Airport
Genera	Generic airspace generated for HFL studies
JFK	John F. Kennedy International Airport
PHL	Philadelphia International Airport
ZDC	Washington Center
ZID	Indianapolis Center
ZJX	Jacksonville Center
ZNY	New York Center
ZOB	Cleveland Center