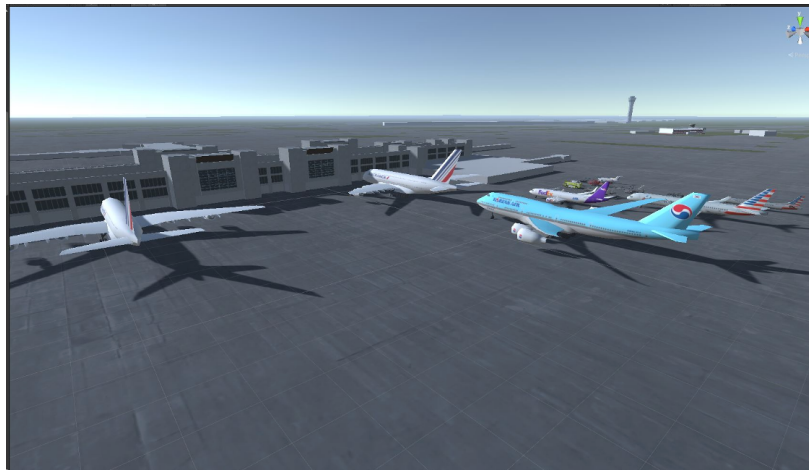




## White Paper

# Runway Incursion Mitigation Solutions for Terminal Air Traffic Controllers



## Executive Summary

For decades, the Federal Aviation Administration (FAA) Air Traffic Organization (ATO) developed and implemented numerous safety initiatives to combat runway incursions. These efforts have incorporated the implementation of physical airport layout improvements, signage, lighting, technology, and training through programs like the Runway Safety Improvement Area (RSA) and the Runway Incursion Mitigation (RIM) Program.

Even with these efforts, runway incursions continue to occur. Since January 2023, there has been a disturbing rise of serious incursions. The Secretary of Transportation convened a runway incursion summit to discuss addressing the rise of incursions with various system stakeholders. Even with the best technology available, communications, awareness levels and misunderstanding remain dominant causal factors in runway incursions.



The ATO Safety and Technical Training Office (AJI-2) is responsible for the development, implementation, and evaluation of innovations and enhancements to air traffic controller training methods, technologies, systems, tools, and/or curricula to support Government-defined objectives that may include, but are not necessarily limited to one or more of the following:

- Improving controller skill development and operational understanding;
- Improving controller performance;
- Increasing training success rates;
- Reducing training time;
- Improving the student's longer-term retention of training course content and skills;
- Improving student preparation for later stage training (e.g., Simulation and OJT);
- Improving training quality and efficiency;
- Improving the consistency and standardization of training delivery and performance assessment;
- Making training more widely available; and integrated across platforms and sites;
- Providing opportunities for self-paced, independent learning;
- Optimizing the use of training resources (instructors, facilities, etc.);
- Providing access to NextGen training, contingency training, supplemental training, refresher training, and skill enhancement training 24/7, without interruption of qualification training in radar labs.

Gamified microsimulations provide a viable, efficient, and affordable solution to improve situational awareness and communications skills to further mitigate runway incursions and overall expertise of the tower operational environment. Microsimulations target

specific operational scenarios unique to a facility, or generic part task exercises for skill enhancement and supplemental training needs. Microsimulations can be delivered through on demand cloud applications on FAA iPads and other mobile platforms.



TransLumen has leveraged its years of experience and lessons learned in the Federal Aviation Administration (FAA) Air Traffic Control (ATC) domain, and set the innovation path to design, develop, and expand serious gamification for Academy and Professional Controllers in Training at facilities with relevant part-task and sim mode scenarios for the En Route, Terminal RADAR and Tower environment.

The use case for deploying microsimulation apps is the development of multidevice Communication for “On Demand” applied training systems which allows accessing learning tools anytime and anywhere by employing distributed mobile applications. TransLumen’s methodologies and proprietary innovations can be applied to all aspects of Tower operations that enhance controller skills in mitigating runway incursions.

TransLumen’s Microsimulation Applications are:

- Engaged with FAA and have been since 2017;
- Numbered > 50 applications for successful mobile microsimulation training;
- Currently in use on FAA iPads and other mobile platforms for instructional use.
- Gamified using TransLumen’s AI Engine with user modifiable capabilities, (thousands of hours of “random yet focused gameplay experience”).
- Developed with ATC Subject Matter Experts (SMEs) for well over 8000 hours for technical input & rigorous testing for accelerated innovation to use case (hi TRL levels).
- Produced with Agile and Rapid Prototyping.
- Designed with the latest Human Factors (User Interface (UI) and User Experience (UX)) optimal design.
- Virtually distributed through Cloud-based backend systems.
- Incorporated using proven scanning and alarm algorithms.
- A creation of innovative embedded learning systems designed for instructional material accuracy.
- Developed for current UX/UI for more immersive(3D) and realistic management of controller roles.
- Employed with data capture algorithms for training results through gameplay.



Situational awareness is essential in critical decision making. TransLumen's Time-based STEGC helps individuals to identify subtle cues and sensitize themselves to the surrounding environment. Testing by the Human Performance

sector of the Navy Research Labs and Office of Naval Research has demonstrated STEGC can improve an individual's ability to capture subtle cues and observational anomalies with 20% improvement through STEGC training. This is important in detecting threats, hazards and performing safe operational control duties and mitigating runway incursions.

TransLumen has SME Human Factors and Scanning expertise to augment advance observational training. Along with STEGC, such expertise solutions can be created to promote:

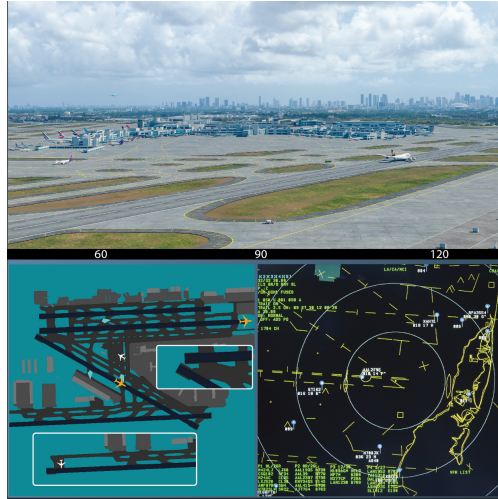
- Enhanced situational awareness for out the Tower views.
- Practicing various scanning patterns such as circular, spiral, linear-horizontal, linear-vertical, linear-diagonal and other techniques.
- Learn scan path exercises to practice identifying conflicts by scanning for altitude, direction of flight, and speed.
- Critical thinking and decision-making skills for technical roles and seldom seen events.
- Techniques to avoid fixation.
- Higher-level demonstration of cognitive and psychomotor skills applied in increasingly complex radar situations.
- Knowledge building and improve retention.

Microsimulation apps with voice recognition and phraseology checks can provide game scenarios with real world applications and techniques built to work with an AI system that is counterintuitive to controller job function and tasks. For runway incursion mitigation, microsimulation scenarios specific to Tower operations could include:



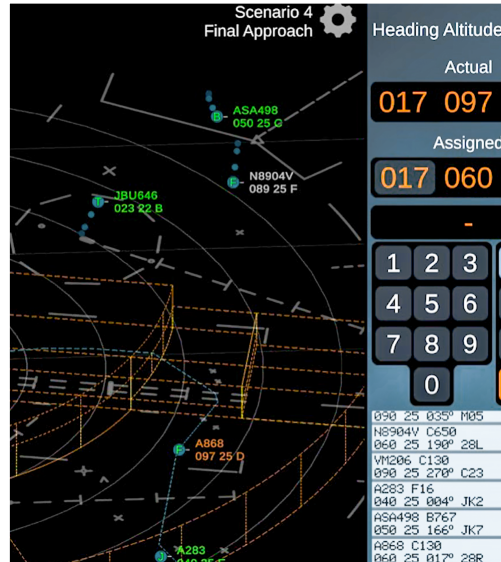
### Ground Control

- Interactive taxiway/airport map for labeling of taxiways, ramps, gates, ARFF locations, parking, critical areas, building locations, taxi restrictions, and runway length;
- Aircraft recognition scenarios for airlines and specific platform types to the subject airport;
- Readback/hearback via Voice AI – (i.e., the system could readback a wrong response; if not caught by controller, alarm player after a period of time);
- Taxiing scenarios, including those that involve cross active runways.



### Local Control

- Scanning exercises- Teach specific scan for subject airport or generic scanning scenarios with realistic out the window (OTW) views;
- Readback/hearback Game as listed above;
- Takeoff Clearance and mileage practice - Scenarios for specific facility or generic, practice exercises to create/maintain initial departure separation;
- Landing Clearance Practice –For specific facility or generic, practice phraseology for Land and Hold Short operations, intersecting runway operations/sequencing, braking action advisory issuance, go-around/missed approaches, readback and hear-back practice as above.



### Impact for the deliverables:

- Capability to create dozens of micro tasking radar scanning apps that will review FAA Directives and instruction regarding controller scanning;
- Micro task development to scan for runway incursions with aircraft identification, separation rules, taxi, and tarmac activity;
- Teach the fundamental ways that radar controllers scan, provide interactive exercises to learn and reinforce scanning skills, and provide feedback of what has been learned correctly or not.

TransLumen augments screen design to achieve the benefits of using next generation alarms and alerts to implement SubThreshold Extreme Gradual Change (STEGC) to aid in de-cluttering and de-noising (reducing visual clutter and visual noise) on the operator's screen(s) along with other error and fatigue reducing technologies and procedures that balance the cognitive load on operators. TransLumen can demonstrate these activities for the FAA with presentations and demos.

Microsimulation provides the added benefit of virtual rapid prototyping and product Modeling. Another derivative benefit of using microsimulation apps is to serve as testbeds for product development that involves building model/tooling products. This lays the groundwork for rapid prototyping with human factors testing before integration into the original equipment manufacturing assembly or software development.

Multiple operational microsimulation scenarios that are agile and co-developed with the system(s) will culminate with high technical readiness levels (TRLs). This methodology will accelerate productization through virtual rapid prototyping, reducing errors and costs.

TransLumen's microsimulation apps employ AI logic and are gamified using the latest technology. Applied to critical technical operations, it offers the user mobile On-Demand Training. Using personalized and modifiable scenarios, learners will have many more hours of unique random scenarios with Micro and Sim operations.

## **Path Forward**

Innovative training tools are required to address an increasingly complex and dynamic airspace and surface operations. Recent airport incursions require new generation controllers to advance their situational awareness, communication, and high-level scanning abilities in realistic operations for Tower and Radar roles. A team of controller SMEs and technical gamified training developers can create an immersive "Microtask App Series" with scanning and speech recognition enabled scenarios providing thousands of hours of practice to bridge the gap between classroom instruction and simulator labs/live air traffic sectors training. Building gamified scenarios that present the controller with improved critical thinking and decision-making skill exercises, will enable the controllers to achieve advanced knowledge, skills, and abilities that will help them mitigate air traffic dynamic risks for safer operations in seldom seen events.

A suite of AI gamified microsimulations can be customized to target skill enhancement, longer-term retention, and part-task training and can be distributed for insertion into the current Controller learning path. Augmenting formal training, with the creation of AI driven micro part-task scenarios deployed through gamified microsimulation, will provide opportunities for self-paced, independent learning, multiplayer student, and instructor oversight. These apps will enable accumulating meta and individual scoring metrics for data analysis to identify those areas of performance to prioritize for further training focus.

The following two slides represents a summary overview:



## Runway Incursion Mitigation Using AI Microsimulation



### Factors Causing Serious Incursion Increases

- Communication misunderstandings
- Complex operations challenges impede situational awareness
- Need for improved scanning capabilities

### Challenges for Training New Air Traffic Controllers & Safety Refresher Training

- Increasing pass rates for qualified candidates
- Continuous training simulator and live operations

### Mitigation Goals

- Achieve more training hours without additional investment in training manpower, physical training assets and employee downtime
- Improve Certification success and skills retention
- Give users the opportunity to focus and target specific complex areas of learning
- Adapt to new generational training methods for personalized learning
- More self-directed play/use time equals more knowledge retention and the opportunity to refresh skills
- Easily distributable mobile applications to reduce training costs (affordability)
- Assessment tool for identifying new recruits through publicly available apps (improve attrition rates)

### Augmenting New Solution

- Real world gamified microsimulation apps with voice recognition and phraseology checks, scanning and situational awareness techniques
- Micro-task scenarios to advance critical thinking and decision-making skills for technical roles and seldom seen events.
- Creation of a suite of AI gamified microsimulations providing thousands of hours of practice to bridge the gap between classroom instruction, simulator lab and live air traffic sectors training
- Enable microsimulation accumulation of meta and individual scoring metrics for data analysis to identify those areas of performance to prioritize for further training focus (supports ATC success)

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