Runway Safety Simulation

The Integration, Demonstration, and Experimentation for Aeronautics Laboratory (IDEA Lab) at The MITRE Corporation’s Center for Advanced Aviation System Development (MITRE/CAASD) combines the newest information technology with systems engineering, modeling, and simulation. This environment provides the flexibility to quickly compare future concept alternatives and deliver scientifically sound results to improve aviation system safety, security, and performance.

To support its efforts toward improving aviation system safety, security, and performance MITRE/CAASD has created a cockpit simulation within the lab infrastructure that incorporates several runway safety technologies that have been fielded or are currently being researched. This simulation provides users the ability to interact with these systems in a real time operational setting to identify potential operational issues and also provides a forum for discussion and review of many runway safety technologies.

Final Approach Runway Occupancy Signal (FAROS)
When pilots are on final approach for landing, darkness or hazy conditions can make it difficult to determine that another aircraft is already on the runway. The Flashing Precision Approach Path Indicator (FPAPI) system provides a visual indication of runway occupancy status directly to landing pilots. When the FPAPI lights begin flashing, the landing pilot is immediately alerted to the possibility of an occupied runway. The IDEA Lab was used to evaluate the onset timing and flash rate of the FPAPI signal to assure that it would effectively convey the intended status information.

Runway Guard Lights (RGLs)
RGLs are yellow flashing lights that designate hold points prior to active runways. They are used to enhance the conspicuity of the taxiway/runway intersection in all weather conditions and help prevent the unintentional crossing of runways by taxiing aircraft. RGLs may be installed in-pavement across the taxiway, or elevated on either side of the taxiway.

Taxiway Lead-on Lighting
A simulator study in the IDEA Lab compared the current lead on light configuration to a newly proposed configuration for the lights to make it more apparent that the airplane was entering a runway. After validation of the effectiveness of this approach in field trials, the Federal Aviation Administration (FAA) implemented a modified lighting configuration for taxiway centerline runway lead-on lights. Under the new standard, the color pattern of taxiway centerline runway lead-on lights mirrors that of the runway lead-off lights, which consists of alternating green and yellow fixtures.
Enhanced Surface Markings

Enhanced Surface Markings are intended to assist in pilot awareness of the runway environment. MITRE/CAASD worked with the FAA to study how modified runway surface marking standards (including adding or extending markings, changing marking colors, and improving signage) might result in improved pilot situational awareness in a simulated operational context. In this work, with the IDEA Lab as a key resource, MITRE/CAASD subject matter experts in the fields of surface safety and human factors, in collaboration with stakeholders, developed specific design recommendations which were then validated in operational tests.

Surface Moving Map

As demonstrated in a series of studies in the IDEA Lab, the Airport Surface Situational Awareness (ASSA) application is intended to reduce the likelihood of pilot disorientation on the airport surface by superimposing the pilot’s current position on a map of the airport surface. The electronic surface map display includes the depiction of ownship position on the airport, runways, taxiways, holding areas, ramps, hangars, and other prominent airport structures. The surface moving map display can also give important information about nearby traffic, such as ground speed and current heading, to help the pilot anticipate the behavior of other traffic.

Runway Status Lights (RWSLs)

RWSLs are a lighting system that clearly indicates the status of runway activity to pilots to prevent runway collisions. RWSLs provide this indication in the form of red lights on the taxiway centerline (Runway Entrance Lights—REL), on both sides of the runway centerline (Takeoff Hold Lights—THL), and at runway intersections (Runway Intersection Lights—RIL). When the surveillance-driven RWSL system detects an unsafe situation on the runway, RELs, THLs, and/or RILs illuminate, depending on the nature of the condition. Several alternative light configurations were evaluated in the IDEA Lab to determine which would be most effective in conveying runway status information to pilots so that they could make timely judgments regarding the safety of surface movements such as runway crossings or takeoffs.