

Foreign Object Damage (FOD) Detection and Removal System

Foreign object damage (FOD) costs the aviation industry approximately \$12B worldwide. FOD accounts for approximately 4% of total USAF mishap costs with an average cost per FOD mishap of \$300K and a median cost per FOD mishap of \$118K. FOD has destroyed three aircraft at a cost to the taxpayers of more than \$66M. FOD can also injure DoD personnel when jet blast propels FOD at high velocities.

FOD is preventable. Historical data indicates that most foreign objects are found on the ramp and taxiway areas with about 5% of the debris on the runway. On behalf of DSOC's Acquisition and Technology Programs (ATP) TF Aviation Safety Technology Working Group, the NDCEE identified and demonstrated a foreign object removal system at **Dyess AFB and Yuma Marine Corps Air Station (MCAS)**. The FY11 demonstrations showed the technology has the potential to greatly decrease the man hours currently spent on FOD mitigation efforts at DoD airfields, while at the same time decreasing the number of FOD incidents.

Technology Description

FOD detection technologies use radar and/or electro-optical sensors. Currently, aircrew members and airfield maintenance personnel serve as the primary "sensors" to detect foreign objects during FOD walks. Airfield managers report spending (on average) 1,800+ man hours each month on FOD walks. FOD walks are supplemented with FOD sweepers. Using advanced technology to locate FOD will improve efficiency and reduce man hours spent on FOD walks.

The NDCEE demonstrated the Trex Enterprises Corporation (Trex) FOD Finder that detects, maps, and removes FOD from all areas of an airfield. The system is mounted on a vehicle. It includes a radar sensor with video capture capabilities and on-board data processing controlled by a tablet computer, which serves as the interface with the user. The radar incorporates a 78-81 gigahertz (GHz) sensor mounted on a reciprocating platform that allows scanning a field of approximately 80° in front of the vehicle. The antenna tilt is fixed in relation to the vehicle, scanning at the rate of 30 images per minute and providing a detection distance in front of the vehicle of approximately 200 meters (m) with a detection "cell" of approximately 1m by 1m.

The FOD Finder system also features a high quality Global Positioning System (GPS) that can be calibrated to reach near differential GPS accuracy. A camera can be mounted to the roof of the vehicle. As the FOD is retrieved, it is photographed, and the system generates a label for it. The label includes date, time, and location information in print and bar coding. FOD items are

numbered sequentially in order of detection. The display also includes a data table requiring user action to confirm the disposition of FOD items detected. Each photograph is stored with other FOD information in the on-board computer.

During demonstration testing, neither test location had a FOD-related incident during the time the FOD Finders were in operation. The foreign object removal

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Based on the NDCEE demonstration, FOD Finders may be applicable for use across the DoD.

systems had a Fully Mission Capable (FMC) rate of 98.2% at both locations, well above the targeted 95% rate. At Dyess AFB, the FOD Finder detected 12,430 items with 289 items (3%) found on the runway and 12,141 items (97%) found on the taxiways/ramp. At Yuma, the unit detected, in a shorter period of time, 2,954 items with 1,056 (35%) being detected on the runway and 1,898 (65%) found on the taxiway/ramp.

Technology Benefits

- Covers the same area nearly three times as fast and in nearly half the time as the current sweeper
- Can be configured to meet the specific needs of each installation

Technology Limitation

- The radar system is under continuous improvement to enhance its ability to differentiate foreign objects from the background clutter.

NDCEE FY11 Accomplishments

- Identified commercially available FOD detection and removal technologies
- Drafted and coordinated Concept of Operations (CONOPS), Memoranda of Understanding (MOUs); identified and trained wing personnel on how to operate the FOD Finder system
- Produced a government-approved test plan that listed test goals and evaluation criteria; initiated operational test and evaluation of the system (six months of data collection)
- Conducted periodic reviews of the program and system effectiveness to determine modifications to equipment or operations
- Determined system effectiveness, configuration operations, and number of systems required
- Coordinated feedback with the stakeholders
- Submitted Final Report for the Foreign Object Detection/Removal System Demonstration Initiative

Economic Analysis

In a cost comparison, the annual cost of a FOD finder and operator, \$128,305, was more cost effective than the cost, \$277,500, of the current FOD clearance method using FOD walk and a sweeper.

Suggested Implementation Applications

FOD detection and removal technologies are applicable at military and commercial airfields.

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Applicable NDCEE Task

FY 2010 Development, Demonstration, Evaluation and Implementation of Defense Safety Oversight Council (DSOC) Mishap Reduction Initiatives to Increase Sustainability Enhance Mission Readiness Across the Department of Defense (DoD) (Task N.0712)



Airfield managers report spending an average of 1,800 man hours each month to detect items like these found during a "FOD walk."