ACRP Problem Statement No. 14-04-05 **Recommended Allocation: --**

Developing Cost Effective Foreign Object Debris Detection Systems

ACRP Staff Comments: Recommend reducing the funding level to $300,000.

TRB Aviation Group Committees Comments: AIRCRAFT/AIRPORT COMPATIBILITY: An extension of previous studies of Gigapan technology. Great idea, but not the highest priority; some of the tasks proposed are very open-ended and costly.

Review Panel Comments: Not recommended.—The objective of the proposed research is to develop an economic solutions for FOD detection, which is an open ended research proposal that doesn't seem reasonable to develop in two years. There are many other parallel issues on FOD. There are already several systems in place that do this. Suggested new methodologies can take a while to implement.

AIRPORT COOPERATIVE RESEARCH PROGRAM PROBLEM STATEMENT

ACRP *Problem Number:* **14-04-05**

I. PROBLEM TITLE

Developing Cost Effective Foreign Object Debris Detection Systems

II. BACKGROUND

Foreign object debris (FOD) is defined as any unattached object on the pavement surface within the airport operation area that can cause personnel injury or aircraft damage. Aircraft parts, aircraft supplies, cargo, luggage, tools, construction equipment, soil, rocks, runway pavement deterioration, ice, and wildlife are examples of FOD (FAA 2010). FOD is most often found within the apron area, however FOD located on the runway is most dangerous. Hazardous conditions at the airfield runway develop when aircraft engines ingest FOD or when landing gear tires collide with FOD.

FOD leads to injury and aircraft damage. Aircraft damage includes: damaged engine blades, tire replacement, and aircraft body damage. Consequently, FOD is not only a safety hazard, but costly. The average repair of a FOD strike is $10,000 (McCreary 2010). Repair costs for an aircraft engine due to a FOD strike average $33,000. Conversely, repair for a tire hit averages $2000. $4 billion in total costs (direct & indirect) is spent annually for aircraft repair, flight delays, and airport maintenance (Vogel 2007).

The Federal Aviation Administration (FAA) requires 139 Certificated Airports to have a self-inspection program that includes FOD detection (FAA 2004). Advisory Circular (AC) 150/5210-24 outlines procedures to develop and manage an airport foreign object debris program (FAA 2010). The FAA requires a daily, daylight FOD inspection. Additionally, Advisory Circular (AC) 150/5210-24 describes preventing, detecting, removing, and evaluating FOD (FAA 2010). Detecting and removing FOD in a timely manner is critical in ensuring safe runway conditions. Consequently, daily intermittent runway inspections and pilot observations for FOD are inadequate.

The majority of airports inspect for FOD by performing a daily visual FOD inspection. Conversely, a limited number of airports have FOD detection equipment that continuously surveys the runway surface for FOD. FOD detection equipment is discussed in AC 150/5220-24 (FAA 2009), which specifies minimum equipment performance requirements. Four types of technology-based FOD detection systems are included in the AC:

- stationary radar,
- stationary electro-optical,
- stationary hybrid radar and electro-optical, and
- mobile radar

The stationary systems use fixed sensors positioned along the runway. Airport personnel are alerted by these systems when FOD is detected. Stationary systems provide continuous FOD monitoring, however are cost prohibitive to most airports. Consequently, economically based FOD detection systems should be developed to provide a bridge between the visual drive-the-runway inspection procedure that is typically used and the technology based continuous monitoring systems that are available but costly.

III. OBJECTIVE

Summarize existing electronic practices used to detect FOD and develop new economical approaches for FOD detection that can be adopted easily by most airports.

IV. PROPOSED TASKS

- Summarize existing electronic practices used to detect FOD. The survey should include domestic and foreign airports and manufacturers.
- Develop new economical approaches for FOD detection that can be adopted by most airports.
- Prioritize FOD detection approaches as a function of effectiveness and cost.
- Implement the proposed FOD detection methodologies at an airport to validate the procedure.

V. ESTIMATED FUNDING

Estimated problem funding: $400,000

VI. ESTIMATED RESEARCH DURATION

Research period: 2.0 years

VII. RELATED RESEARCH

Preliminary work has been conducted at the University of Arkansas (UA) to develop an economically based FOD detection system. The (UA) system is an example of a possible economical alternative that serves as an intermediate step between the typically used drive-the-runway visual procedure and electronic stationary systems (Heymsfield & Kuss 2013).

VIII. PROCESS USED TO DEVELOP THE PROBLEM STATEMENT

Extension of a RNS discussed in the AV070 Focus Group meeting with ACRP led by Daniel Findley to develop RNS (February 6, 2013).

IX. PERSON DEVELOPING THE PROBLEM STATEMENT AND DATE

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Federal Aviation Administration (FAA). "Airport Design." Advisory Circular 150/5300-13A, Washington, D.C., 2012.

Federal Aviation Administration (FAA). "Airport Foreign Object Debris Management." Advisory Circular 150/5210-24, Washington, D.C., 2010.

Federal Aviation Administration (FAA), "Airport Foreign Object Debris Detection Equipment," Advisory Circular 150/5220-24. Washington, D.C. 2009.

Federal Aviation Administration (FAA), Title 14 Code of Federal Regulations Part 139, Airport Certification, Washington, D.C., 2004.

Heymsfield, E. and Kuss, M., "Implementing GigaPan Technology into an Airport's Foreign Object Debris (FOD) Management Program," Transportation Research Record, accepted for publication.

McCreary, I. *Runway Safety: FOD, Birds, and the Case For Automated Scanning*, Insight, SRI, Washington, D.C., 2010.

Vogel, B. FOD Systems Advance, Jane's Airport Review, Vol. 19, No. 2, 2007.