Michigan State University College of Engineering and the Boeing Company have been awarded a contract worth up to $4 million from the U.S. Air Force to develop new designs of sensors that will better detect cracks in the second- and third-layers in airframe structures.

Lalita Udpa, professor of electrical and computer engineering in MSU’s College of Engineering, leads the effort to create a next generation of sensors that will identify aircraft structure that has been weakened by subsurface cracks and corrosion.

“Airplanes are made of multiple layers of aluminum that are held together by thousands of fasteners,” she said. “Cracks can develop at the fastener sites in areas of high stress.

“Our job is to develop and apply simulation models for the design of a sensor that can reliably detect cracks that are deep into the third layers in the presence of other complex edges and magnetic materials.”

Udpa said MSU was the Air Force Research Laboratory’s first choice as a research partner to work with Boeing.

“We’ll spend about 18 months designing and testing new sensor concepts and designs in the laboratory. Boeing will then build a portable system integrated with an on-aircraft scanner and validate their performance in the field,” she said. “During this phase, MSU will use the feedback from Boeing to further fine-tune the design.”

Electromagnetic sensor systems that incorporate magnetoresistive, or MR, detectors have been shown to have better capabilities than conventional current sensors for detecting cracks in thick and/or complex metallic airframes.

Udpa said the MR sensors will enable inspections of critical areas of an aircraft, minimizing the need for disassembly of the structure, thus decreasing the maintenance burden to ensure aircraft are structurally sound.

“The sensor packaging will need to be durable and reliable enough for daily on-aircraft inspection processes,” she said.

Udpa is an expert in nondestructive evaluation, or NDE, and has worked in the field for more than 20 years. NDE is similar to biomedical imaging, where X-rays and other methods are used for noninvasively visualizing the interior of organs.
“There aren’t many universities in the country with a long history of NDE experience,” she said. “Michigan State is among the few.”

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