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News

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

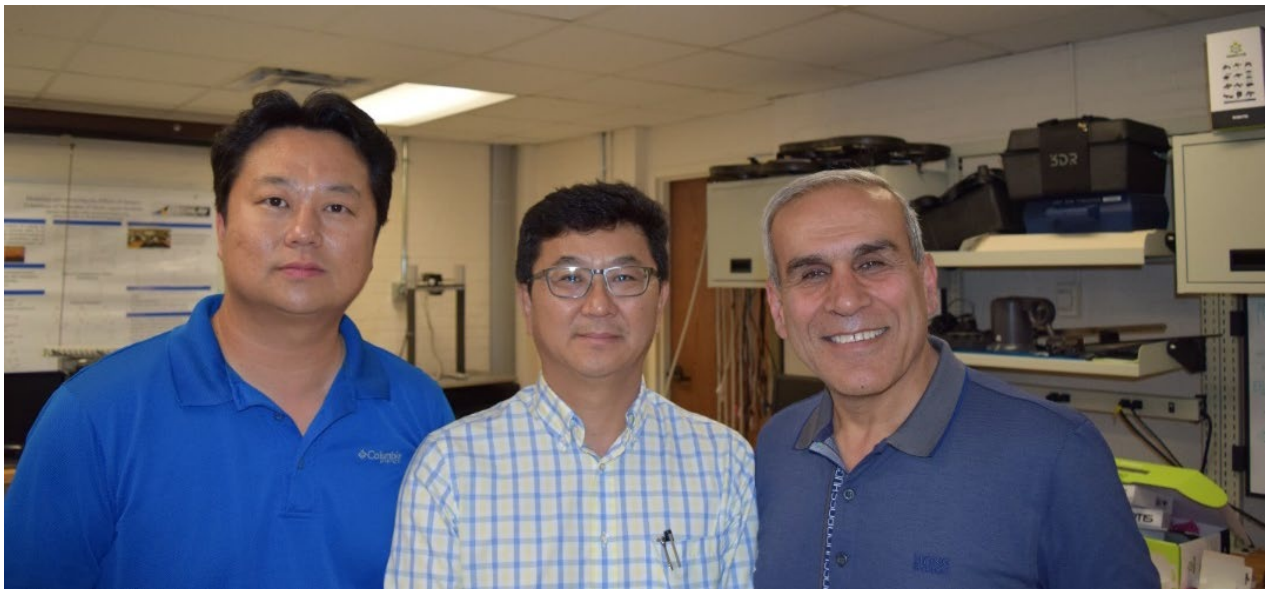
Watching What We Cannot See

The Savannah River Site (SRS) is a nuclear industrial complex owned by the United States Department of Energy (DOE). It covers 310 square miles and is bordered on the southwest by the Savannah River, which separates South Carolina from Georgia.

Greensboro, NC – August 30, 2019 – During the 1950s, SRS started producing tritium and plutonium-239, materials used in nuclear weapons. Five reactors and support facilities were built to produce these nuclear materials, with irradiated materials being moved from the reactors to chemical separation plants where they were processed to separate useful products from waste. After refinement, resulting nuclear materials were shipped to other DOE sites for final application. The site produced about 36 metric tons of plutonium from 1953 to 1988.

When the Cold War ended, the United States no longer needed vast quantities of nuclear materials and a new direction took shape: cleaning up the nation's Cold War legacy and downsizing its nuclear complexes. Nuclear sites across the country were closed down, and their materials sent to the South Carolina site for safekeeping.

Supporting these safekeeping measures are the thrust of one of N.C. A&T's research efforts. Three A&T scientists are using unmanned autonomous robots and vehicles to assist Savannah



N.C. A&T researchers: Dr. Sun Yi, autonomous robots and vehicles; Dr. Younho Seong, decision making and data analysis; Dr. Sameer Hamoush, concrete structures.

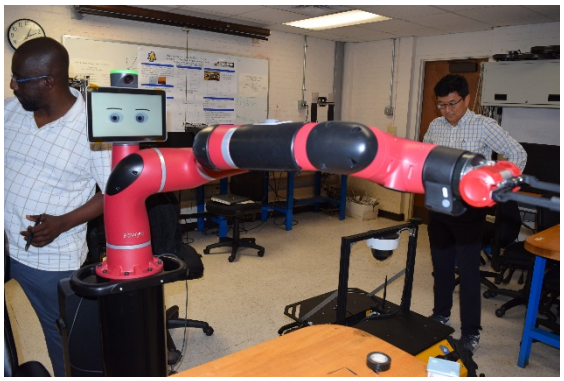
River Nuclear Solutions (SRNS), the present-day site manager, in its storage, handling and maintenance of the radioactive materials in the facilities.

Drs. Sun Yi, Younho Seong and Sameer Hamoush represent three different departments within N.C. A&T's College of Engineering, and 2019 marks their third year of research in support of SRNS. Their project, called *Tele-Operated Robots with Remote Sensors and Automated Detection Aids for Decision Making in Highly Safety-Critical Concrete Structures*, allows SRNS to see and understand what is happening in the underground tunnels where the radioactive waste is stored. By using autonomous robots and vehicles, in this case ground-based rovers and robot arms, A&T scientists are able to be present in areas otherwise off-limits to human traffic.

The ground-based rover which will hold the team's flexible arm including 3-D camera.

The SRNS storage tunnels are made of concrete, which can deteriorate over time. It is important for the SRNS team to detect weaknesses in their storage structures so they can take action to correct vulnerabilities long before they become a threat to the environment.

At the program's inception in 2016, the N.C. A&T research team used nondestructive sensors with cameras mounted on a ground-based rover to send information back to the team above ground. Today's technology allows for far more precise and useful data gathering. "What started out as photo taking in 2016 has progressed to a rather complex mapping exercise," explains Dr. Sun Yi, one of the project's Principle Investigators. "By using today's LiDAR technology we are able to examine the man-made tunnel environments with stunning accuracy and precision."



A team member calibrates the flexible arm which will hold the camera used for non-destructive testing of the tunnel walls.

LiDAR, Light Detection And Ranging, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges within the SRS tunnels providing three-dimensional information about the shape of the tunnel and its surface characteristics. It also allows the A&T team to create a complete coordinate map of the underground facility using GPS technology; at the conclusion of this year's project, the team will have a complete map with SLAM (simultaneous localization and mapping) coordinates of every position in the storage tunnel. "When we detect a vulnerability in the structure going forward, it will be mapped with exact coordinates, allowing us greater insight as we find, monitor and eventually address flaws in the structure."

Therein lies the future of N.C. A&T's relationship with SRNS. With the photographic capabilities proven and the robust mapping exercise almost complete, the next frontiers of this research project are even more exciting. New equipment will provide Drs. Yi, Seong and Hamoush the opportunity to perform non-destructive testing of the concrete tunnel surfaces. By using a sophisticated 3-D camera mounted on a powerful, flexible arm, the next generation rovers will be able to not only detect visible surface cracks, but scan inside the concrete structures for hidden vulnerabilities invisible to the human eye.

"In the future, we hope to move beyond the non-destructive testing phase, and assist Savannah River Nuclear Solutions with remediation," said Yi. "We believe the autonomous vehicle technologies we use now to photograph, map and see inside structures will expand to facilitate the repairs we will need to accomplish in the coming years."