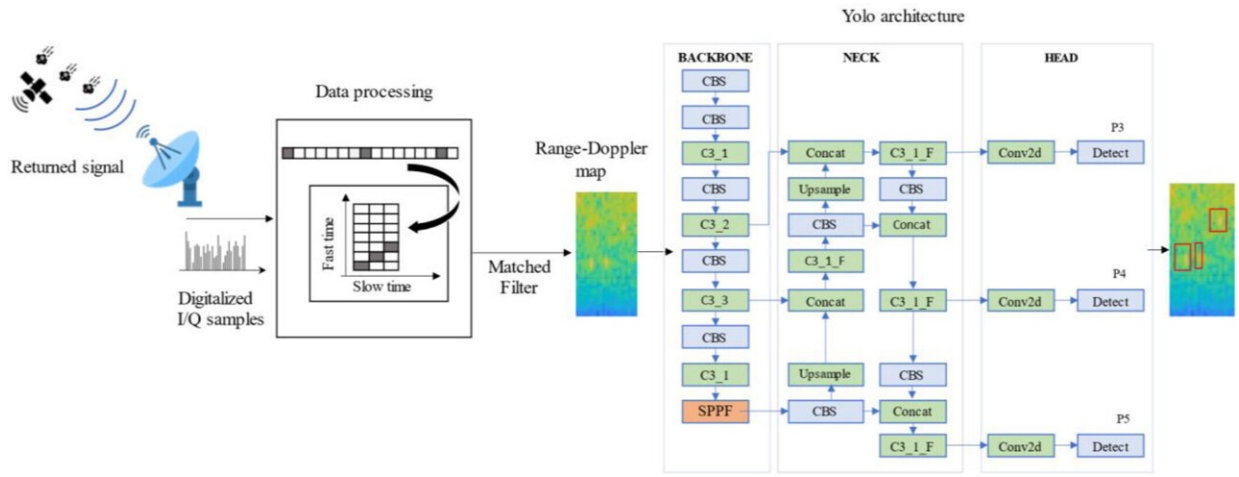
Study find potential benefits in AI–based systems for spotting hard-to-detect space debris

March 6 2024



Simplified block diagram of a generic pulse-doppler radar system and consequent digital processing, with the introduction of YOLO-based moving target detector after the matched filter. Credit: *IET Radar, Sonar & Navigation* (2024). DOI: 10.1049/rsn2.12547

An increasing number of space objects, debris, and satellites in Low Earth Orbit poses a significant threat of collisions during space operations. The situation is currently monitored by radar and radio-telescopes that track space objects, but much of space debris is composed of very small metallic objects that are difficult to detect.

In a study published in *IET Radar, Sonar & Navigation*, investigators demonstrate the benefits of using deep learning—a form of artificial intelligence—for small space object detection by radar.

The team modeled a prominent radar system in Europe (called Tracking and Imaging Radar) in tracking mode to produce training and testing data. Then, the group compared classical detection systems with a You-Only-Look-Once (YOLO)–based detector. (YOLO is a popular object detection algorithm that has been widely used in computer vision applications.)

An evaluation in a simulated environment demonstrated that YOLO-based detection outperforms conventional approaches, guaranteeing a high detection rate while keeping false alarm rates low.

"In addition to improving space surveillance capabilities, artificial intelligence–based systems like YOLO have the potential to revolutionize space debris management," said co–corresponding author Federica Massimi, Ph.D., of Roma Tre University, in Italy.

"By quickly identifying and tracking hard-to-detect objects, these systems enable proactive decision-making and intervention strategies to mitigate collisions and risks and preserve the integrity of critical space resources."

More information: Federica Massimi et al, Deep learning-based space debris detection for space situational awareness: A feasibility study applied to the radar processing, *IET Radar, Sonar & Navigation* (2024). DOI: 10.1049/rsn2.12547

Provided by Wiley