# Low-Slow-Small (LSS) target detection based on micro doppler analysis in forward scattering radar geometry


## ABSTRACT

The increase in drone misuse by civilian apart from military applications is alarming and need to be addressed. This drone is characterized as a low altitude, slow speed, and small radar cross-section (RCS) (LSS) target and is considered difficult to be detected and classified among other biological targets, such as insects and birds existing in the same surveillance volume. Although several attempts reported the successful drone detection on radio frequency-based (RF), thermal, acoustic, video imaging, and other non-technical methods, however, there are also many limitations. Thus, this paper investigated a micro-Doppler analysis from drone rotating blades for detection in a special Forward Scattering Radar (FSR) geometry. The paper leveraged the identified benefits of FSR mode over conventional radars, such as improved radar cross-section (RCS) value irrespective of radar absorbing material (RAM), direct signal perturbation, and high resolutions. To prove the concept, a received signal model for micro-Doppler analysis, a simulation work, and experimental validation are elaborated and explained in the paper. Two rotating blades aspect angle scenarios were considered, which are (i) when drone makes a turn, the blade cross-sectional area faces the receiver and (ii) when drone maneuvers normally, the cross-sectional blade faces up. The FSR system successfully detected a commercial drone and extracted the micro features of a rotating blade. It further verified the feasibility of using a parabolic dish antenna as a receiver in FSR geometry; this marked an appreciable achievement towards the FSR system performance, which in future could be implemented as either active or passive FSR system.



**Keyword:** Micro doppler; Forward scatter radar (FSR); Low-Slow-Small (LSS) target detection