EGU22-4826, updated on 14 Aug 2022
https://doi.org/10.5194/egusphere-egu22-4826
EGU General Assembly 2022

A 24 GHz MIMO radar for the autonomous navigation of unmanned surface vehicles

Giovanni Ludeno, Gianluca Gennarelli, Carlo Noviello, Giuseppe Esposito, Ilaria Catapano, and **Francesco Soldovieri**
Institute for Electromagnetic Sensing of the Environment, National Research Council of Italy, Via Diocleziano 328, 80124, Napoli, Italy

In the last years, unmanned surface vehicles (USVs) in marine environment have attracted considerable interest since they are flexible observation platforms suitable to operate in remote areas on demand. Accordingly, their usage has been proposed in several contexts such as research activities, military operations, environmental monitoring and oil exploration [1]. However, most of current USV remote control techniques are based on human-assisted technology thus a fully autonomous USV system is still an open issue [2].

The safety of the vehicle and the ability to complete the mission depends crucially on the capability of detecting objects on the sea surface, which is necessary for collision avoidance. Anti-collision systems for USVs typically require measurements collected from multiple sensors (e.g. Lidar, cameras, etc.), where each sensor has its own advantages and disadvantages in terms of resolution, field of view (FoV), operative range and so on [3].

Among the available sensing technologies, radar is capable of operating regardless of weather and visibility conditions, has moderate costs and can be easily adapted to operate within the marine environment. Furthermore, radar is characterized by an excellent coverage and high resolution along the range coordinate and it is also able to guarantee a 360° FoV in the horizontal plane.

Nautical radars are the most popular solutions to detect floating targets on the sea surface; however, they are bulky and not always effective in detecting small objects located very close to the radar.

This contribution investigates the applicability of a compact and lightweight 24 GHz multiple-input multiple-output (MIMO) radar originally developed for automotive applications to localize floating targets at short ranges (from tens to few hundreds of meters). In this frame, we propose an ad-hoc signal processing strategy combining MIMO technology, detection, and tracking algorithms to achieve target localization and tracking in a real-time mode. A validation of the proposed signal processing chain is firstly performed thanks to numerical simulations. After, preliminary field tests carried out in the marine environment are presented to assess the performance of the radar prototype and of the related signal processing.

References

- [1] Zhixiang et al. "Unmanned surface vehicles: An overview of developments and challenges", *Annual Reviews in Control*, vol. 41, pp. 71-93, 2016
- [2] Caccia, M. Bibuli, R. Bono, G. Bruzzone, “Basic navigation, guidance and control of an unmanned surface vehicle”, *Autonomous Robots*, vol. 25, no. 4, pp. 349-365, 2008
- [3] Robinette, M. Sacarny, M. DeFilippo, M. Novitzky, M. R. Benjamin, “Sensor evaluation for autonomous surface vehicles in inland waterways”, *Proc. IEEE OCEANS 2019*, pp. 1-8, 2019.