

Centre de Recherche de l'École de l'Air – UR 09.401



RECRUIT

Job title: PostDoctoral or Research engineer position in signal processing and telecommunications for airborne passive radar detection

Workplace: Salon de Provence – Bouches du Rhône - France

Main scientific domain: Telecommunications, signal processing, radar

Category: Level I

Type of contract: CDD fixed-time contract **Period of contract:** from 12 to 19 months max

Amount of work: Full time (opportunities to travel in the Paris region (Onera Palaiseau) or abroad.

Gross monthly salary :

- PostDoctoral (0 to 3 years after thesis defence) : 2 575,37 €
- Research engineer (3 to 5 years after thesis defence) : 2 619,02 €

Desired date of assignment: July, the 1st 2023

PRESENTATION OF THE PROFESSIONAL ENVIRONMENT

The Air and Space Academy is a major military school (with EPSCP-GE status) located in Salon-de-Provence, authorized to deliver the title of engineer. It is a member of the Conference des Grandes Écoles and the ISAE group (SUPAERO, ENSMA, ESTACA, The Air and Space Academy). It is responsible for the initial training of all Air Force and Space Force officers.

PRESENTATION OF HOST STRUCTURE

The Centre de recherche de l'École de l'Air (CREA), is the multidisciplinary research unit of the Air and Space Academy. It is closely linked to the 701 Air Force Base, which gives it the rare ability to access aeronautical resources such as aircraft or flight zones. It also maintains partnerships with major players in the defence and aeronautics sectors (DGA, CEA, ONERA, Dassault Aviation, SAFE competitiveness cluster) as well as academics (Aix-Marseille university, ISAE group schools, IRSEM, etc.).

The CREA is composed of about thirty research professors from many disciplines: history, sociology, political science, mathematics, fluid and structural mechanics, cognitive science, computer science, signal processing. Its members conduct academic research with a common object: the determinants of the evolution of the military use of aeronautical and space systems.

DESCRIPTION OF ACTIVITIES

Context

You will work on a project, in partnership with Onera (Electromagnetism and Radar Department), related to airspace surveillance by passive radar. Passive radar offers a significant complement to low and very low altitude air coverage, in rural or urban areas. Totally discreet and consisting only of a receiver, the electromagnetic sources used are already present in the environment. In addition, the mobility of the airborne passive radar adds significant flexibility compared to the fixed ground-based radar and thus increases the resilience of the system. The improvements proposed in the project should increase the probability of detection and thus allow the detection of targets with a small radar equivalent area.

To achieve these objectives, you will work on the basis of DVB-T (Digital Video Broadcast-Terrestrial) signals. These signals have been digitised during test campaigns and experimental measurements carried out at the Salon de Provence air base. The team has a ground and airborne passive radar demonstrator. It can acquire its own real signals on the ground, but it can also be configured to be embedded in a nacelle of Onera's BUSARD motor glider.

Work to be done

The work carried out within the framework of the postdoc will focus more specifically on improving the processing of real DVB-T signals in order to increase the probability of radar detection. Indeed, the ultimate detection step is entirely dependent on the upstream phases of the processing, i.e. the rejection of spurious contributions and the matched filter. The latter two rely heavily on the estimation of the reference signal, i.e. on the estimation of the signal emitted by the illuminators of opportunity. In this sense, the main scientific question raised is the improvement of the estimation of the reference signal, in order to limit the impact of clutter as much as possible. The evaluation of the contribution of clutter rejection techniques will be carried out by considering two zones: the endo-clutter zone and the exo-clutter zone (polluted by the secondary lobes of this clutter in the absence of rejection techniques). Indeed, the challenge is to limit as much as possible the undesirable effects produced by the direct path and the multipaths creating strong and diffuse secondary lobes in distance/doppler that can mask the targets of interest. It will therefore be necessary to find new processing methods that can be applied, such as inverse filtering, mismatched filtering, exploitation of channel decoding, or STAP-type methods, in order to increase detection capacities and demonstrate the feasibility of an airborne passive radar.

These methods will be developed within the framework of the mission in Matlab. For some of them, you will rely on existing elements in the literature. This will be the case, for example, for the channel decoding method. On the other hand, for all the methods to be developed, adaptations will be made to the particular case of airborne passive radar. These tools can then be applied to simulated and/or real data obtained during a previous measurement campaign.

You will promote your research work and contribute to the reputation of the Air and Space School through publications in scientific journals and participation in national and international conferences and seminars.

Bibliography

C. Berthillot, A. Santori, O. Rabaste, D. Poullin & M. Lesturgie, BEM reference signal estimation for an airborne passive radar antenna array, IEEE Transactions on Aerospace and Electronic Systems, Vol. PP (99), pp. 1-12 (2017).

C. Berthillot, A.Santori, O.Rabaste, D.Poullin, M.Lesturgie, DVB-T Airborne Passive Radar: clutter block rejection. International Radar Conference (2019)

C. Berthillot, A.Santori, O.Rabaste, D.Poullin, M.Lesturgie, DVB-T airborne passive radar : clutter analysis and experimental results, IEEE RadarConf (2019).

D. Poullin, O.Rabaste, C.Berthillot, A.Santori, Reference signal restitution in passive radar, PCL focus day, Avril 2021

PROFIL / SKILLS REQUIRED

- Researcher, PhD with a background in signal processing, telecommunications;
- You have experience in the field of detection;
- You will ensure the reliability and relevance of the results obtained;
- Practice of technical English (oral and written) is essential (TOEIC \geq 785) ;
- Oral fluency and ability to write technical reports, scientific articles (in French and in English) and to present scientific and technical results;
- Autonomy and sense of responsibility;
- European Union citizens.

PRATICAL INFORMATION

Restaurant on site. Nurseries and schools in the area. Access to the sports facilities of the Air and Space Academy. Sports and arts club: many activities for executives and families. Very active social and festival committees.

The document listed below should only be sent to the contracts listed in the job description:

- An academic resume,
- A cover letter,
- a letter of recommendation (if possible),
- the report of the defence.

The first contact will be made by simply sending a CV to the scientific referent.



CONTACTS FOR THE SUBMISSION OF APPLICATIONS:

- **Scientific referent:** Agnès Santori – Enseignant chercheur
Email : agnes.santori@ecole-air.fr
- **Direct supervisor:** CDT Jérôme Mistretta – Directeur du CREA
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- **Collective Management Office HR PC** - Marie-France MARMORET
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Deadline for applications : january, the 31th 2023