



Tribunal Nº 12

Área Global 9. Tecnología Aeroespacial, Naval y de Defensa

Especialidad T3: Guiado, Navegación e Inteligencia artificial. INTA

Segundo Ejercicio de la fase de Oposición

Practical Case 1: Development of robust navigation systems against jamming and spoofing in highly dynamic environments.

Problem Description:

In a highly dynamic environment, such as a fleet of autonomous vehicles or drones in delivery operations, robust navigation systems are required to withstand jamming (intentional signal interference) and spoofing (signal falsification) attacks. These attacks can affect the accuracy and reliability of navigation systems, jeopardizing the safety and efficiency of operations.

Objective:

Formulate technological and innovative initiatives to develop robust navigation systems against jamming and spoofing attacks in highly dynamic environments.

Steps to Follow:

1. **Research:** Detail the concepts of jamming, spoofing, and the challenges associated with navigation in highly dynamic environments. Indicate existing technologies used to mitigate these attacks and the maturity of these technologies.
2. **Context Analysis:** Analyse the specific context in which this solution will be applied, considering the type of autonomous vehicles or drones involved, environmental conditions, applicable regulations, among other relevant factors.
3. **Requirements Identification:** Identify key requirements for developing robust navigation system against jamming and spoofing in highly dynamic environments. These may include accuracy, resistance to interference, adaptability to rapid changes, robustness, among others. Identify the required technical infrastructures, facilities and specific hardware, software and tools.
4. **Idea Generation:** Generate at least two creative and technologically feasible ideas to address the identified requirements. Consider solutions based on interference detection and mitigation algorithms, signal authentication and verification techniques, among other possibilities. Propose the adequate infrastructure, facilities and tools required for this development.



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5. Testing: Design the testing plan to be conducted to assess the effectiveness of the solution. Include real or simulated testing scenarios to evaluate the main performances such as accuracy, robustness, or resistance to interference.

6. Presentation: Prepare a concise scheme summarizing the proposed initiative, highlighting benefits, technological challenges, and potential impact on innovation.



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Practical Case 2: Improvement of Satellite Navigation System and applicable services for a Military Autonomous vehicle concept.

Problem Description:

This practical case is aiming at exploring how to use Galileo satellite navigation system services, in combination with Configurable Radiation Pattern Antenna (CRPA) on a software-defined radio to improve the accuracy and robustness of navigation in an autonomous vehicle.

Scenario: Imagine you work for a leading autonomous vehicle technology company and are tasked with improving the navigation system for a new military autonomous car development. The contract requirements include incorporating the use of Galileo satellite navigation services, the global satellite navigation system developed by the European Union, to ensure strategic independence. In addition, the engineering team has developed a software-defined radio (SDR) that allows greater flexibility and control over the antennas used for receiving signals from different Global Navigation Satellite System (GNSS).

Objective:

Formulate technological and innovative initiatives to implement and test a Satellite Navigation System based on the combination of Galileo services with the use of Configurable Radiation Pattern Antenna (CRPA) to be used in the development of a military autonomous vehicle with the goal of demonstrating how this innovative concept improves accuracy and reliability of navigation in dense urban environments and adverse conditions.

Steps to Follow:

1. **Research:** Provide a detailed description of the proposed technologies to be used, including an analysis of its maturity and state of development. Consider both the receiver and the antenna configurations.
2. **Context Analysis:** Analyse the specific context in which this solution will be applied, considering the type of autonomous vehicles involved, environmental conditions, applicable regulations especially focus on the military domain, among other relevant factors.
3. **Requirements Identification:** Identify key requirements for improving the accuracy and robustness of satellite navigation system in an autonomous vehicle. Analyse which Galileo services would this application use and identify the limiting factors. Identify key



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requirements to cover the applicability of this solution in the military domain. Identify the required technical infrastructures, facilities and specific hardware, software and tools.

4. **Idea Generation:** Generate at least one creative and technologically feasible idea to address the identified requirements. Consider solutions based on the use of Galileo satellite navigation system services in combination with Configurable Radiation Pattern Antenna (CRPA) on a software-defined radio and propose the adequate infrastructure, facilities and tools required for this development.

For the antenna configuration, include a trade-off analysis of the type of antenna to be used.

5. **Evaluation and Testing:** Propose a testing plan to assess its effectiveness, accuracy and robustness, including real or simulated scenarios to evaluate the expected performance in different locations, including dense urban areas, tunnels, and places with obstacles that may affect the signal.

Include in this plan the answer to these questions:

- 5.1 What type of simulated interference scenarios would you use to evaluate the system's robustness?
 - 5.2 What type of simulated adverse condition scenarios (dense urban environments, urban canyons, forests, tunnels) would you use to evaluate the system's robustness?
 - 5.3 What other type of sensors would you hybridize with these navigators, how would you do it, and why?
6. **Presentation:** Prepare a concise scheme summarizing the proposed initiative highlighting benefits, technological challenges, and potential impact on innovation.