



ERCIM "ALAIN BENSOUSSAN"
FELLOWSHIP PROGRAMME



Scientific Report

First name / Family name	Vijander Singh
Nationality	Indian
Name of the <i>Host Organisation</i>	Norwegian University of Science and Technology (NTNU)
First Name / family name of the <i>Scientific Coordinator</i>	Prof. Robin Trulssen Bye
Period of the fellowship	01/02/2022 to 31/01/2023

I – SCIENTIFIC ACTIVITY DURING FELLOWSHIP

During my ERCIM postdoc scholarship, I explored Explainable Artificial Intelligence (XAI), path planning and collision avoidance algorithms, and intelligent situational awareness for autonomous surface vessels (ASVs).

The goal of the research was to suggest a model that explains the ASV's reasoning for changing its speed or course while navigating along a predetermined path. In order to guide the ship and make decisions throughout the collision course, fuzzy logic was used to capture the expert knowledge based on COLREGs. While creating a decision support system for path planning and collision avoidance for ASVs, I also realize the importance of COLREG rules. An explainable model has been trained using data that has been collected based on expert knowledge. The explainable model predicts the decision's underlying rationale.

Apart from this, I supported Prof. Robin T. Bye and Prof. Ottar L. Osen in applying statistical and AI/ML techniques to help the winch price forecast project for the SEAONICS, Ålesund (Handling technology developer to enable sustainable exploration).

The project's goal was to analyse how AI may enhance product design and costing. I also participated in two "design sprints" of SAFE Maritime Autonomous Technology (SAFEMATE) an Innovation Project for the Industrial Sector in which NTNU is a partner. In these sprints, I learned how ANS should visualize the future situation, handle the collision, how to prioritize the obstacles based on TCPA, CPA, distance and speed etc.. and display alternative routes.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

Vijander Singh, Ottar L. Osen, and Robin T. Bye “Explainable Artificial Intelligence for Autonomous Surface Vessels by Fuzzy-Based Collision Avoidance System”, International Conference on Smart Trends in Computing and Communications SmartCom-2023, Springer LNNS. ISSN: 2367-3370, Series: <https://www.springer.com/series/15179>
[Accepted for publication]

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

1. Design Sprints for SAFEMATE Project “Collision Avoidance Decision Support” in Ålesund, Norway during 1-3 March 2022.
2. Design Sprints for SAFEMATE Project “Augmented Reality Layers” in Oslo, Norway during 15-16 March 2022.
3. “European Conference on Modelling and Simulation ECMS-2022” at NTNU, Ålesund, Norway during May 30-June 03, 2022.
4. Conference on “IE and IIR Day” in Trondheim, Norway during 14-15 June 2022.
5. Workshop on “IoT Course on LoRaWAN and Bluetooth Low Energy (BLE) Technologies” organized by Department of ICT and Natural Sciences, NTNU, Ålesund during 7-9 September 2022.
6. IIR’s meeting at Thon Hotel Fosnavåg, Norway during 6 – 7 October 2022.
7. Workshop on “Scientific writing” organized by Department for Research, Faculty of Information Technology and Electrical Engineering, NTNU, Ålesund on 02/12/2022.

IV – RESEARCH EXCHANGE PROGRAMME (REP)

I visited Institute of Informatics, Warsaw University, Warsaw, Poland for research exchange program (REP) during 26-30 September 2022. During the REP, I shared my proposed research training program proposal, progress till date in that regard and research going on at CPS Lab, NTNU, Ålesund with local supervisor Prof. Piotr Sankowski. He also introduced me with his research and development centre IDEAS NCBR operating in the field of artificial intelligence and digital economy, whose mission is to support the development of these technologies in Poland by creating a platform that connects the academic and business environments.