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| FP-logo-100-25-100-25 | **ERCIM** "**ALAIN BENSOUSSAN**" **FELLOWSHIP PROGRAMME** | | logo_ERCIM |
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| Scientific Report | | | | |
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| First name / Family name | | Oucheikh Rachid | | |
| Nationality | | Moroccan | | |
| Name of the *Host Organisation* | | NTNU - Ålesund | | |
| First Name / family name  of the *Scientific Coordinator* | | Robin T. Bye | | |
| Period of the fellowship | | 01/06/2018 to 31/05/2019 | | |

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| **I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP** |
| The main research activity carried out during my ERCIM Alain Bensoussan Fellowship Programme is related to Autonomous Surface Vessels (ASV). In fact, the need for autonomous systems on waters with increased safety requires development of guidance, navigation and control technology. On the higher level stand guidance algorithms that include path planning and collision avoidance. Therefore, the focus on our research is the comprehension of the surface vessels' guidance technology, survey of existing solutions and development of new path planning and collision avoidance techniques. The ultimate goal is to enhance safety, optimize operations, and improve performance. With higher levels of automation it should be possible to comply with COLREGs and fill many objective functions (reduce fuel costs, reduce operational costs, improve regularity, optimize paths,…). |

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| **II – PUBLICATION(S) DURING YOUR FELLOWSHIP** |
| Under submission: JMST-Springer  Title: “A Review on Path Planning and Collision Avoidance for Autonomous Surface Vessels”  Abstract: Nowadays the concept of autonomous surface vessels is gaining increasing attention with their potential benefits of improving safety and efficiency. According to the statistics, more than half of the accidents of ships are associated with path planning and collision avoidance issues. To autonomously resolve these two issues, several artificial intelligence techniques such as evolutionary algorithms, artificial potential fields, fast marching methods and many others have been successfully tested and used. The safety aspect in collision avoidance can be improved by respecting specific collision regulations on waters (COLREGs).  This paper reviews guidance and more specifically path planning and collision avoidance techniques of autonomous surface vessels and classification of them. Autonomy of vessels, guidance, navigation and control components including path smoothing and advances in the industry are discussed in the paper.  Under submission: JMST-Springer  Title: “A comparison of Path Planning and Collision Avoidance Algorithms for Autonomous Surface Vessels”  Abstract: In recent years several artificial intelligence techniques such as evolutionary algorithms, artificial potential fields, fast marching methods and many others have been successfully used for solving vessels path planning issue. This paper reviews guidance and more specifically path planning and collision avoidance techniques of autonomous surface vessels, gives an overview of several advantages and drawbacks of the algorithms employed, and compares paper contributions according to a set of defined properties and characteristics.  Published: ICMSAO’19 IEEE proceedings  Title: “Path Planning in Dynamic Environment Using Particle Swarm Optimization”  Abstract: Path planning is an important guidance task that allows autonomous mobile robots and vehicles to achieve their goal or fulfill their mission. In this paper, a path planning algorithm based on Particle Swarm Optimization (PSO) is proposed. This algorithm is able to perform natural and smooth maneuvers from source to destination while ensuring the safety of the autonomous robot and its surroundings. The optimization criteria consist of collision-free path length, travel time and energy consumption. Various test scenarios are used to test the success of the proposed method to generate feasible and optimal solutions.  Simulation in Unity3D is used to illustrate and validate the proposed approach. Simulation results show that the proposed approach is efficient and optimal in terms of relevant objective functions for various test scenarios. |
| **III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES** |
| ICMSAO’19: The International Conference on Modeling, Simulation and Applied Optimization (ICMSAO’19) is the eight of the series of conferences and provides an international forum for presentations and discussion of research in all areas of science and engineering involving the modeling, simulation and applied optimization of processes and systems.  Date: April 15-17, 2019  Place: Bahrain  NFEA’18: With Main theme of the year: Future maritime technologies, Maritime operations, From remote controlled to self-propelled vessels. Advanced Vessels 2018 look ahead, where autonomous vessels, remote control, human aspect and hydrogen reduction are central issues. The conference provides insight into topics related to future maritime operations and operations.  Place: Ulsteinvik, Norway  Date: November 21-22, 2018 |

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| **IV – RESEARCH EXCHANGE PROGRAMME (REP)** |
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* Name of the REP organisation: CWI
* Country: Netherlands
* Research group: “Intelligent and autonomous systems group” – Amsterdam
* Local scientific coordinator: Prof. Eric Pawels
* Dates: 8-12/04/2018
* Experience: The visit was very fruitful and full of rich discussions with all group members.