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Ship Motion Prediction with Deep Learning using IMU Data and Images

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Lance De Waele

2022

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# Foreword

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# Abstract

(English)

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# Extended abstract

(Nederlands)

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# List of Abbreviations

AI: Artificial Intelligence

ASV: Autonomous Surface Vessel

IMU: Inertial Measurement Unit

LSTM: Long Short Term Memory

CNN: Convolutional Neural Network

NN: Neural Network

ReLU: Rectified Linear Unit

# Introduction

In the last few years, the world has seen an exponential increase in technological advancements. This evolution brought with it a new influence of autonomous systems controlled by artificial intelligence (AI). Each of these systems designed with its own goals and characteristics, optimized for its task. More and more of these systems are being deployed as a direct or indirect replacement for tasks humans could do, but also, for tasks humans can’t physically do. And because these autonomous systems are optimized for specific jobs, they can be more accurate and faster at it than humans.

Because autonomous systems can replace the position of a human, they are especially useful in military and defense operations. They can take over the role of a human in dangerous environments and therefore eliminate the risk of someone’s life. On the other hand they can also be used as a complimentary asset, providing support and aid in logistics. More and more of these autonomous assets such as drones, surface vessels, tanks and reconnaissance vehicles are being deployed around the world for various different objectives. But with this increasing amount of autonomous assets, there is need for communication between them, to allow them to work together and be aware of the state of each other when they need to interact.

Afbeelding met water, buiten, geel, transport

Automatisch gegenereerde beschrijving“*Interoperability is the key that acts as the glue among the different units within the team, enabling efficient multi-robot cooperation.”* (Royal Higher Institute for Defence, 2022)

Figure 1: Autonomous Surface Vessel (ASV)

The Robotics & Autonomous Systems lab of the Belgian Royal Military Academy is currently working on two autonomous vehicles in two projects named MarSur and MarLand. Project MarSur is developing an autonomous surface vessel (ASV) (figure 1) that will interact with a drone that is being developed by project MarLand. The drone needs to be able to take-off and land on the ASV. This proposes a challenge since the ASV is continuously moving due to sea waves. For a smooth landing to be possible, the ASV must be capable to calculate it’s state and predict it’s movement in the ocean to determine the optimal time for the drone to land, so that the impact on the drone will be minimized and the ASV is as stable as possible. To facilitate this, the ASV is equipped with an Inertial Measurement Unit (IMU) and stereo camera’s providing the necessary data for these predictions.

In this paper, a deep learning model will be constructed the can predict the state and motion of the ASV. The model will use data from the IMU and stereo camera’s, and output a sequence of parameters describing the shop motion. Different models will be analyzed and compared with each other to find which one has the best performance.

# Literature

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