IMPLEMENTATION OF EMISSIONS ASSESSMENT INTO A SHIP ROUTING ALGORITHM IN A SHORT SEA SHIPPING ROUTE

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Key words: weather ship routing (WSR), emissions assessment, fuel consumption.

ABSTRACT

Maritime transport is one of the sources for global warming and environmental pollution. The environmental impact of shipping is expressed by atmospheric emissions as result of the combustion of fossil fuel emissions among other impacts as could be spills or underwater noise, for instance. Shipping accounted in 2012 for approximately 2.8% of global greenhouse gas (GHG, including CO₂, CH₄, and N₂O) emissions. Shipping is responsible for 15% and 13% of global NOₓ and SOₓ emissions respectively in 2012 ([1], [2]).

Moreover, it is estimated a growth in the world seaborne trade in the near future on account of world’s growing population, which exacerbates air pollution forecasts from maritime transport. As a result, the IMO has developed and adopted more stringent regulations aimed to significantly decrease emissions from vessels. These air pollution regulations focus on reduction of CO₂, NOₓ, SOₓ and PM, since they are the main emissions of vessel engines.

Various measures and methods are proposed to reduce the environmental impact of shipping like slow steaming, the use of alternative fuels like hydrogen or LNG, or technical and design optimizations; although reducing fuel consumption points out as to be the major aspect for achieving shipping competitiveness. This agrees with an increase of the world tendency to reduce air emissions in the framework to mitigate the climate change effects. ([3])

From the shipping industry point of view this may be achieved with an optimum route plan design. Academic research has focused the ship routing optimization through pathfinding algorithms which take into account the meteo-oceanographic forecasts (i.e. wind, waves or currents predictions). Some of these contributions have been tested through a “proof-of-concept” based in oceanic distances. However, at relative short-distance the route shipping optimization remains unexplored. In this case, the spatial resolution of the meteo-oceanographic predictions is a severe restriction. ([4], [5])

The use of ship routing systems can lead to the reduction of fuel usage together with a reduction of costs. Consequently, a mitigation of carbon emissions could happen due to the avoidance of bad weather conditions. ([6])

The objective of this contribution is to implement emissions assessment into a ship routing algorithm in a relative short distance route (case study) using high-resolution wave numerical products. The ship routing will be defined as the development of an optimum sailing course and speed for ocean voyages based on nautical charts, forecasted sea conditions, and possibly the individual characteristics of a ship for a particular transit.

This research will deal firstly with identifying the parameters which are required for energy consumption and emissions on board presently. A theoretical fuel consumption can be calculated.
by using the energy related parameters in energy and mass balances following from diesel engine theory. One or more parameters could serve as proxy which presents information about the fuel consumption of a vessel without presenting the direct fuel consumption. Subsequently, an inventory of methods to calculate fuel consumption and/or CO₂ emissions will be elaborated. Finally, the potential best suitable method will be assessed by combining the monitored parameters and the method inventory. The aforementioned method will be found by assessing if the relevant parameters already are monitored/available on board for the reviewed methods, by ranking of methods by scoring for its feasibility costs, accuracy, implementation and by the outcome of each method in relation with research objectives.

Once the most suitable method is chosen, a real scenario will be analysed by means of introducing the required data on current ship routing algorithm.

The obtained new knowledge will help to bring at local scale to an unprecedented level of resolution of weather ship routing (WSR) and, furthermore, the expected results will reflect the benefit of using WSR systems at relative short distances and its impact on fuel consumption benefits, and the reduction on emissions.

REFERENCES


