SHIP EMISSIONS CALCULATION BY USING AIS DATA

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{ STIAN GLOMVIK RAKKE } NTNU,
DEPARTMENT OF MARITIME ENGINEERING

OBJECTIVES

This thesis aims to calculate global emissions from ship traffic. More specifically, the target is to utilize AIS data for development of a method that estimate fuel consumption. It should take use of known ship design rules and power prediction approximations. From this power prediction a specific fuel oil consumption is calculated and emissions could be derived. This method should only make use of input from AIS data.

CONTRIBUTIONS

This thesis develops a method for estimating global fuel consumption without ship databases. Emission is derived from this. Main contributions from this work are:

- Simplifies emissions calculation drastically
- Independent from commercial parties
- Targeted estimates of emissions for area and time period

INTRODUCTION

As a vital enabler for global trade and prosperity shipping constitutes a large share of the worlds transportation of commodities. Hence, ship emissions has received great focus in recent years. GHG emission from shipping accounted for approximately 2.4% [1] of global emissions in 2012. Several goals for reducing emission has been introduced. Extensive work has been done to implement new regulations in the shipping industry to meet these goals. An effort to measure total emissions in world shipping fleet has consequently needed new research, as shipping data earlier has been insufficient.

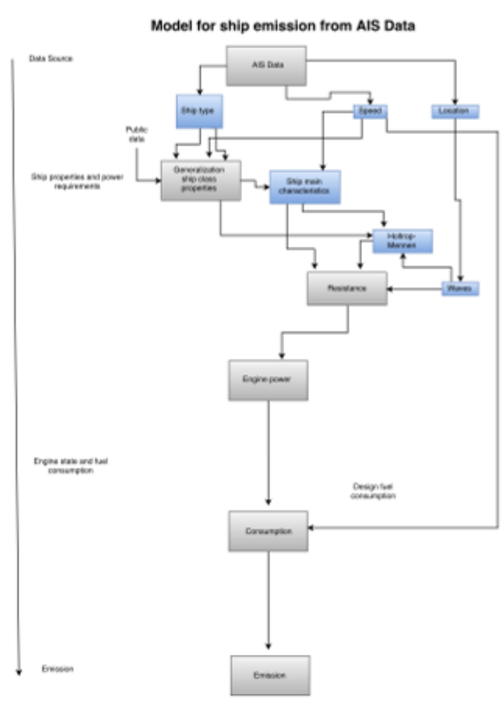
Automatic Identification System (AIS) was initially introduced as an anti collision system; providing live ship tracking along with identification number and several main ship characters. This has later been exploited in different research areas as AIS provide and gather a significant amount of data. Emissions calculation studies has been conducted through AIS analysis of ship journeys.This is combined with ship databases that contains ship main characteristics.An example of this is [2] a modelling system for exhaust emission of marine traffic in the Baltic sea.

HOLTROP-MENNEN

Holtrop-Mennen is an empirical method of power prediction for ships [3]. From Holtrop-Mennen effective power (P_E) and resistance (R_T) are estimated. Main ship characteristics used in this method are as follows:

- Length on waterline, L
- Length between perpendiculars, L_{PP}
- Breadth moulded, B
- Draught moulded on F.P., T_F
- Draught moulded on A.P. , T_A
- Displacement volume moulded, Δ
- Longitudinal center of buoyancy
- Transverse bulb area, A_{BT}
- Center of bulb area above keel line, h_B
- Midship section coefficient, C_M
- Waterplane area coefficient, C_{WP}
- Transom area, A_T
- Wetted area appendages, S_{APP}
- Stern shape parameter, C_{STERN}
- Propeller diameter, D
- Number of propeller blades , Z
- Clearance propeller with keel line, $-$
- Ship speed, V

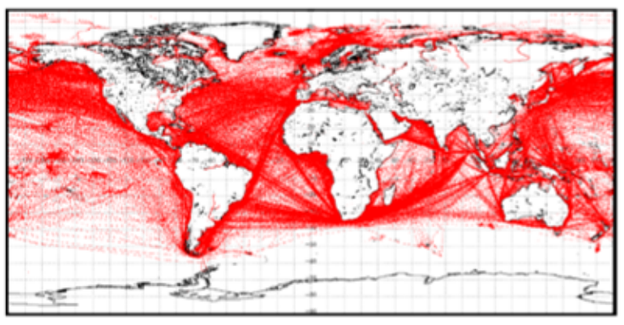
ECAIS METHOD



Figur 1: Emissions calculation method from AIS data

The Emission calculation from AIS data (ECAIS) method estimate fuel consumption by using Holtrop-Mennen for ship resistance and power prediction. Holtrop-Mennen takes main ship characteristics as input. Some of these characteristics are given directly from AIS. Rest of the characteristics are found through literature survey which gives an approximate value for given ship sizes and types. From ship resistance power prediction is derived. An approximate fuel consumption table based on the estimated engine power are applied, Ship speeds given from AIS data are used for finding the specific fuel oil consumption for each distinct ship. Computer scripts are applied for calculations for all AIS messages. This gives a an approximated ship consumption for the given data input, and from this emissions are derived.

AIS



Figur 2: Global AIS observations from AISSat-1 for September 2011 (Helleren et al.,2012)

Automatic Identification System was initially introduced as an anti collision system; providing live ship tracking along with identification number and several main ship characters. The messaging system let ships electronically exchanges data for safe voyage.

Recent year specially dedicated satellites has been launched, receiving larger number of AIS messages and wider coverage. This is called S-AIS
In Figure 2 all AIS message observations by AISSat-1 (Norwegian AIS satellite) from September 2011 are plotted. This shows the coverage area for S-AIS. In contrast, base stations for AIS only have a reach of up to 40-50 miles offshore

DATA COLLECTION

Raw AIS data from Kystverket are used. The data set contains approximately 1,562,718 SAIS messages of type 1-5 from May 1, 2014 to September 15, 2014. Each message contains the time stamp of when it was sent in addition to the actual AIS message.

REFERENCES

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[3] J.Holtrop and Mennen G.G.J. An approximate power prediction method. 1982.

CONTACT INFORMATION

Email stianrakke@gmail.com
Phone +47 980 26 986
Supervisor Bjørn Egil Asbjørnslett