SUMMARY

[0006] According to a first aspect of the present invention, there is provided a method for use with a marine vessel. The method comprises: obtaining data identifying a marine vessel and data identifying a voyage to be undertaken by the marine vessel; computing a fuel consumption estimate using a predictive model, the predictive model being configured to receive the data identifying the marine vessel and the data identifying the voyage to be undertaken as input, parameters for the predictive model being fitted using historical data for a plurality of marine vessels and a plurality of voyages; and determining an amount of fuel to be supplied to the marine vessel based on the fuel consumption estimate, wherein the marine vessel is configured to consume a plurality of fuel types, and wherein computing the fuel consumption estimate using the predictive model comprises computing fuel consumption estimates for the plurality of fuel types.

[0007] The fuel consumption estimate may be used to appropriately supply (i.e. load) a marine vessel with fuel for a voyage over one or more network legs. The fuel consumption estimate may help to optimally load a marine vessel to reduce fuel consumption and improve vessel efficiency, in turn reducing pollution levels. The fuel consumption estimate may also avoid emergency refuelling operations, such as refuelling at sea.

[0008] Optionally, the method comprises controlling the supply of the determined amount of fuel to the marine vessel.

[0009] Optionally, the data identifying the marine vessel comprises an indication of a class of the marine vessel, and the historical data for the plurality of marine vessels comprises indications of class for the plurality of marine vessels.

[0010] Optionally, the data identifying the voyage to be undertaken comprises an identification of a leg of a voyage, the leg of the voyage having an arrival port and a departure port, wherein the predictive model is configured to receive the identification of the leg of the voyage as input.

[0011] Optionally, the method comprises determining a distance between the arrival port and the departure port; and determining an estimated mean speed of the marine vessel for

[0019] Optionally, the method comprises: obtaining an initial fuel consumption estimate for each of the first and second fuel types, wherein the first predictive model is configured to receive the initial fuel consumption estimate for the first fuel type as an input, and wherein the second predictive model is configured to receive the initial fuel consumption estimate for the second fuel type and an indication as to whether the initial fuel consumption estimate for the second fuel type is non-zero as inputs.

[0020] According a second aspect of the present invention, there is provided a fuel control system for a marine vessel, comprises: an interface to receive data identifying the marine vessel and data identifying a voyage to be undertaken by the marine vessel; a memory to store computer program code to implement a predictive model and parameter values for the predictive model, the parameter values resulting from an optimisation of the predictive model using historical data for a plurality of marine vessels and a plurality of voyages; a processor to retrieve the computer program code and the parameter values from the memory. The processor is arranged to execute the computer program code to: instantiate the predictive model using the parameter values; supply the data identifying the marine vessel and the data identifying the voyage to be undertaken by the marine vessel to the predictive model; and apply the predictive model to determine a fuel consumption estimate for the marine vessel for the voyage. The fuel control system also comprises a fuel supply system to determine an amount of fuel that is supplied to at least one fuel tank of the marine vessel based on the fuel consumption estimate, wherein the marine vessel is configured to consume a plurality of fuel types, and wherein applying the predictive model to determine the fuel consumption estimate comprises computing fuel consumption estimates for the plurality of fuel types.

[0021] According a third aspect of the present invention, there is provided a non-transitory computer-readable storage medium stores instructions that, when executed by a processor, cause the processor to: obtain data identifying a marine vessel and data identifying a voyage to be undertaken by the marine vessel; determine a class of the marine vessel from the data identifying the marine vessel; determine a voyage leg identifier, a voyage duration, and a voyage speed based on the data identifying the voyage; obtain initial fuel consumption estimates for each of a first fuel type and a second fuel type, the initial fuel consumption estimates being based on a fuel consumption rate at the voyage speed for the marine vessel and the voyage duration; apply a first predictive model to output an adjusted fuel consumption

CLAIMS:

1. A method comprising:

obtaining data identifying a marine vessel and data identifying a voyage to be undertaken by the marine vessel;

computing a fuel consumption estimate using a predictive model, the predictive model being configured to receive the data identifying the marine vessel and the data identifying the voyage to be undertaken as input, parameters for the predictive model being fitted using historical data for a plurality of marine vessels and a plurality of voyages; and

determining an amount of fuel to be supplied to the marine vessel based on the fuel consumption estimate,

wherein the marine vessel is configured to consume a plurality of fuel types, and wherein computing the fuel consumption estimate using the predictive model comprises computing fuel consumption estimates for the plurality of fuel types.

2. The method of claim 1, comprising:

controlling the supply of the determined amount of fuel to the marine vessel.

3. The method of claim 1 or 2, wherein the data identifying the marine vessel comprises an indication of a class of the marine vessel, and the historical data for the plurality of marine vessels comprises indications of class for the plurality of marine vessels.

4. The method of any one of claims 1 to 3, wherein the data identifying the voyage to be undertaken comprises an identification of a leg of a voyage, the leg of the voyage having an arrival port and a departure port, wherein the predictive model is configured to receive the identification of the leg of the voyage as input.

5. The method of claim 4, comprising:

determining a distance between the arrival port and the departure port; and

determining an estimated mean speed of the marine vessel for the voyage,

wherein the predictive model is configured to receive the distance and the estimated mean speed as inputs.

6. The method of any one of claims 1 to 5, wherein the predictive model is a linear model and parameters of the linear model are fitted using elastic net regularization.

7. The method of any one of claims 1 to 6, wherein the predictive model comprises:

parameters that are independent of the data identifying the marine vessel;

parameters that are dependent on the data identifying the marine vessel;

parameters that are independent of the data identifying the voyage to be undertaken by the marine vessel; and

parameters that are dependent on the data identifying the voyage to be undertaken by the marine vessel.

8. The method of any one of claims 1 to 7, comprising:

obtaining an initial fuel consumption estimate,

wherein the predictive model is configured to receive the initial fuel consumption estimate as an input.

9. The method of claim 8, wherein the initial fuel consumption estimate is computed from data indicating how fuel consumption varies with speed of the marine vessel.

10. The method of claim 8, wherein the initial fuel consumption estimate is received as a user input.

11. The method of any preceding claim, wherein computing fuel consumption estimates for the plurality of fuel types comprises:

computing a first fuel consumption estimate for a first fuel type using a first predictive model;

computing a second fuel consumption estimate for a second fuel type using a second predictive model, and

determining an amount of fuel comprises determining an amount of each of the first and second fuel types that are to be supplied to the marine vessel based on the respective first and second fuel consumption estimates.

12. The method of claim 11, comprising:

obtaining an initial fuel consumption estimate for each of the first and second fuel types,

wherein the first predictive model is configured to receive the initial fuel consumption estimate for the first fuel type as an input, and

wherein the second predictive model is configured to receive the initial fuel consumption estimate for the second fuel type and an indication as to whether the initial fuel consumption estimate for the second fuel type is non-zero as inputs.

13. A fuel control system for a marine vessel, comprising:

an interface to receive data identifying the marine vessel and data identifying a voyage to be undertaken by the marine vessel;

a memory to store:

computer program code to implement a predictive model;

parameter values for the predictive model, the parameter values resulting from an optimisation of the predictive model using historical data for a plurality of marine vessels and a plurality of voyages;

a processor to retrieve the computer program code and the parameter values from the memory, the processor being arranged to execute the computer program code to:

instantiate the predictive model using the parameter values;

supply the data identifying the marine vessel and the data identifying the voyage to be undertaken by the marine vessel to the predictive model; and

apply the predictive model to determine a fuel consumption estimate for the marine vessel for the voyage; and

a fuel supply system to determine an amount of fuel to be supplied to at least one fuel tank of the marine vessel based on the fuel consumption estimate,

wherein the marine vessel is configured to consume a plurality of fuel types, and wherein applying the predictive model to determine the fuel consumption estimate comprises computing fuel consumption estimates for the plurality of fuel types.

14. A non-transitory computer-readable storage medium storing instructions that, when executed by a processor, cause the processor to:

obtain data identifying a marine vessel and data identifying a voyage to be undertaken by the marine vessel;

determine a class of the marine vessel from the data identifying the marine vessel;

determine a voyage leg identifier, a voyage duration, and a voyage speed based on the data identifying the voyage;

obtain initial fuel consumption estimates for each of a first fuel type and a second fuel type, the initial fuel consumption estimates being based on a fuel consumption rate at the voyage speed for the marine vessel and the voyage duration;

apply a first predictive model to output an adjusted fuel consumption estimate for the first fuel type, the first predictive model being a parameterised function of the initial fuel consumption estimate for the first fuel type, the class of the marine vessel, the voyage leg identifier, the voyage duration, and the voyage speed, parameters for the first predictive model being optimised based on historical data for a plurality of marine vessels and a plurality of voyages;

apply a second predictive model to output an adjusted fuel consumption estimate for the second fuel type, the second predictive model being a parameterised function of the initial fuel consumption estimate for the second fuel type, the class of the marine vessel, the voyage leg identifier, the voyage duration, and the voyage speed, parameters for the second predictive model being optimised based on the historical data;

determine an amount of fuel of the first fuel type to supply to the marine vessel based on the adjusted fuel consumption estimate for the first fuel type; and

determine an amount of fuel of the second fuel type to supply to the marine vessel based on the adjusted fuel consumption estimate for the second fuel type.