oFreq

0.4

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Contents

Chapter 1

Introduction

Table of Contents

Chapter 2

Bodies

Todo Documentation on theoretical basis for bodies. Include links to the body coordinate system.

Body Mass

Rigid body mass. Meant for 6DOF rigid body only.

Simulating Additional Mass

You can simulate additional mass items by entering them as a reactive force object.

Body Forces

- Mass Forces
- Reactive Forces - User
  - Can be any order of derivative from 0 to no limit. Very useful for modeling behavior of control systems.
- Reactive Forces - Hydrodynamic
  - Normally automatically included. None if you set the hydrodynamic body name to "none".
- Active Forces - User
- Actve Forces - Hydrodynamic
- Crossbody Forces - User
- Crossbody Forces - Hydrodynamic

Multibody Support

Multibody Support

2.1 Multibody Support

Todo Write theoretical background for multibody support. List the forces that are used for multibody interaction. Include relative coordinate systems how each body has its own coordinate system.

Interacting Forces

Cross-body Force: Hydrodynamic

Cross-body Force: User

Chapter 3

Coordinate Systems

Two coordinate systems are used in ofreq:

Global Coordinates

Body Coordinate System

3.1 Global Coordinates

Todo Write documentation for Global Coordinate system.

Translation Coordinates

Rotation Coordinates

Heading Coordinates

3.2 Body Coordinate System

Todo write body coordinate system documentation.

Translation

Rotation

Relative to Body Motion

Order of Translation and Rotation Application

Specify that first we apply the linear translation, with respect to orientation of the global coordinate system. And then the body is rotated with respect to its own heading.

Chapter 4

Motion Models

Todo Write general purpose information for motion models.

- What are they.
- Why do we need them.
- Do we care about them?
- What can we do with them. Emphasise that they let us convert motions into forces.

Standard Motion Models

Standard Motion Models

Custom Motion Models

You can write your own custom motion models.

Custom Motion Models

4.1 Standard Motion Models

Todo Write page for standard motion models.

Standard Motion Models

6 Degree of Freedom (6 DOF) Motion Model

4.1.1 6 Degree of Freedom (6 DOF) Motion Model

Todo Write 6 DOF motion model documentation. Include all the documentation necessary.

4.2 Custom Motion Models

Todo write documentation for custom motion models. This will be a really important one. So give it some effort. Start with the documentation already present in the source code.

Defining Your Own Motion Models

Available Functions

Custom parameters

Chapter 5

Motion Solver

Todo Write documentation for motion solver. Describe the process. List each of the steps and the relevant equations.

Chapter 6

Outputs

Todo write documentation for outputs page.

Calculation of RAO

All outputs include the absolute magnitude of response. And the response amplitude operator (RAO) for that output. RAO's are their own list, given separately after the absolute response.

Basic Feedback Outputs

Wave Directions

Wave Frequencies

Wave Spectra

Global Solution Outputs

Global Derivative

Global Motion

Global Velocity

Global Acceleration

Local Solution Outputs

Local Derivative

Local Motion

Local Velocity

Local Acceleration

Force Outputs

Global Forces

Local Forces

Power Outputs

Outputs about power are often used for research into items such as wave energy extraction devices. They may also be useful for preliminary assessments of body structures.

Power

Efficiency Outputs

These are some customized outputs used by ofreq for efficiency assessments of wave energy extraction devices.

Absolute Efficiency

Relative Efficiency

Human Tolerance Outputs

Sometimes, human tolerances are the limiting criteria for seakeeping performance. Ofreq includes outputs for classice algorithms on human tolerance, based on the ship motions.

Motion Sickness Index

Subjective Motion Assessment

6.1 Wave Directions

Todo write documentation for wave directions.

Output

Calculation Method

Limitations

Application to Custom Motion Models

RAO Calculation

State how the RAO is calculated. For every output, ofreq calculates both the true response value, and the RAO for that value. They are listed sequentially. First the response, then the RAO.

RAO Normalization.

Sometimes it can be very confusing which part of the input wave properties are used to normalize the output. This section should explicitely state how the RAO was calculated.

RAO Units

Sometimes it can be very confusing what the units of an RAO are. So this should clarify.

6.2 Wave Frequencies

Todo write documentation for wave frequencies.

Output

Calculation Method

Limitations

Application to Custom Motion Models

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6.3 Wave Spectra

Todo write documentation for wave spectra. This is feedback to the user to show exactly what magnitude of wave spectra ofreq calculated for each specified wave direction.

Output

Calculation Method

Limitations

Application to Custom Motion Models

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6.4 Global Derivative

Todo write documentation for global derivative.

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6.5 Global Motion

Todo write documentation for global motions.

Output

Calculation Method

Limitations

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6.11 Local Acceleration

Todo write documentation for local acceleration.

Output

Calculation Method

This calculation should include the $sin(\theta)$ terms. For example:

$$\ddot{x}_2 = ... + gsin(\theta)$$

Limitations

Application to Custom Motion Models

$$|I_2| = \left| \int_0^T \psi(t) \left\{ u(a,t) - \int_{\gamma(t)}^a \frac{d\theta}{k(\theta,t)} \int_a^\theta c(\xi) u_t(\xi,t)\, d\xi \right\} dt \right|$$

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6.12 Global Forces

Todo write documentation for global forces

Output

Calculation Method

Limitations

Application to Custom Motion Models

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6.14 Power

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Calculation Method

Limitations

Application to Custom Motion Models

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6.15 Absolute Efficiency

Todo write documentation for Absolute Effciiency. Refer back to the Porpoise Buoy documentation. That should have some useful stuff on the various types of efficiency calculated.

Output

Calculation Method

Limitations

Application to Custom Motion Models

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6.17 Motion Sickness Index

Todo write documentation for Motion Sickness Index. There will probably also be some inputs to enter.

Output

Calculation Method

Limitations

Application to Custom Motion Models

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6.18 Subjective Motion Assessment

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Output

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Chapter 7

Resonant Solver

Todo Write documentation for resonant solver. List each of the steps. May also need to include another fundamentals section on eigen-value problems.

Still in Development

Chapter 8

Sea State Definition

Todo Write sea state definition guide.

Slight note: There is often debate within the naval architecture community of the proper spelling of the word sea state. In this documention, we will use it as two words to recognize the fact that any sea state is composed of two components.

- Wave direction variation
- Wave frequency variation

Direction Models

Wave direction variation. Be warned that because the program allows definition of radically different models between wave spectra, the program must use linear interpolation between defined wave directions. So use closely spaced wave directions to reduce interpolation errors when it really matters.

Wave Direction Models

Wave Spectra

Wave frequency variation. Several models are avaiable within ofreq.

Wave Spectra

8.1 Wave Direction Models

Todo write documentation for wave direction models.

Header 1

Model Cos^2 Wave Direction Model

8.1.1 Model Cos^2 Wave Direction Model

still in development

Todo Write the documentation for the Wave Direction Model - cos^2

8.2 Wave Spectra

Todo Write wave spectra page.

ITTC (Bretschneider) Wave Spectra

JONSWAP Wave Spectra

Ochi 2 Parameter Wave Spectra

Pierson-Moskowitz Wave Spectra

Todo Add other spectra to the list of wave spectra.

8.2.1 ITTC (Bretschneider) Wave Spectra

Still in Development

Todo Write documentation for ITTC Wave spectra.

8.2.2 JONSWAP Wave Spectra

Still in Development

Todo Write documentation page for JONSWAP wave spectra.

8.2.3 Ochi 2 Parameter Wave Spectra

Still in Development

Todo Write Documentation for Ochi 2 Parameter Wave Spectra.

8.2.4 Pierson-Moskowitz Wave Spectra

Still In Development

Todo Write documentation for Pierson-Moskowitz Wave Spectra

Chapter 9

Seakeeping Fundamentals

Todo Expand the seakeeping fundamentals section. A little introductory knowledge.

Frequency Domain Aanalysis

Linear Algebra

Waves

Wave Interactions with Bodies

Hydrodynamic Data

9.1 Frequency Domain Aanalysis

Todo write frequency domain analysis page. Maybe something from Wikiwaves will suffice. Or something from Wikipedia about a Fourier transform.

Frequency Decomposition

Limitations of Frequency Domain Analysis

9.2 Linear Algebra

Todo Include an explanataion of linear algebra. Try to just include a quick explanation and maybe a link to a wikipedia page.

9.3 Waves

Todo write waves section of seakeeping fundamentals.

Wave Composition

Waves with Multiple Directions

9.4 Wave Interactions with Bodies

Todo Write wave interactions background page. Maybe I can find some PDF lecture notes from a seakeeping class and paste them in here. Far less effort to use the work of others and credit them. Much easier than writing my own seakeeping class.

Incident Waves

Diffracted Waves

Radiated Waves

9.5 Hydrodynamic Data

Todo Write background documentation for hydrodynamic data. Include important things, like the fact that all of the data varies with both frequency and direction.

Added Mass

Added Damping

Hydrostatic Properties

Chapter 10

Verification

Todo write page about verification.

- Briefly explain what verification is.
- The only major equation that needs verification is the derivative one.
  - That one is easy enough to show since there is an algebraic equivalent for the derivative.

What is Verification

The Need for Verification

Verification of Time Derivative

Chapter 11

Individual Wave Calculations

Todo write documentation for individual wave calculations

Calculation from Sea State Definition

Note: This documentation will alsways speak in terms of *wave amplitude*, not height. Although wave height is more convenient, ofreq tried to maintain a clear and consistent representation for all inputs. Therefore, all inputs are expected in their base, strict, mathematically correct format. It may be inconvenient, but it is consistent, simple, and universally known. This reduces chances for misunderstanding.

Non-Linear Wave Amplitude

Non-Linear Wave Amplitude Calculation

Hydrodynamic Coefficients

Hydrodynamic Coefficients

11.1 Non-Linear Wave Amplitude Calculation

Todo write documentation for non-linear wave amplitude calculation.

Still in Development

Motivation

Linear Wave Amplitude Calculation

Non-Linear Wave Amplitude Calculation

Criteria

11.2 Hydrodynamic Coefficients

Still in Development

Todo write documentation for hydrodynamic coefficients.

Non-linear Hydrodynamic Coefficients

The program does consider non-linear interpolation between wave amplitudes.

Chapter 12

Definitions

Todo Write definitions of common terms used in ofreq. See if I can find some way to generate a list that will automatically link the terms. I may need to trick Doxygen to believe that definition is a function or some other similar piece of code.

Chapter 13

Todo List

Page 6 Degree of Freedom (6 DOF) Motion Model

Write 6 DOF motion model documentation. Include all the documentation necessary.

Page Absolute Efficiency

write documentation for Absolute Effciiency. Refer back to the Porpoise Buoy documentation. That should have some useful stuff on the various types of efficiency calculated.

Page Bodies

Documentation on theoretical basis for bodies. Include links to the body coordinate system.

Page Body Coordinate System

write body coordinate system documentation.

Page Custom Motion Models

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Page Frequency Domain Aanalysis

write frequency domain analysis page. Maybe something from Wikiwaves will suffice. Or something from Wikipedia about a Fourier transform.

Page Global Acceleration

write documentation for global acceleration.

Page Global Coordinates

Write documentation for Global Coordinate system.

Page Global Derivative

write documentation for global derivative.

Page Global Forces

write documentation for global forces

Page Global Motion

write documentation for global motions.

Page Global Velocity

write documentation for global velocity.

Page Hydrodynamic Coefficients

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Page Hydrodynamic Data

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Page Individual Wave Calculations

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Page Local Forces

write documentation for local forces

Page Local Motion

write documentation for local motion.

Page Local Velocity

write documentation for local velocity.

Page Model Cos^2 Wave Direction Model

Write the documentation for the Wave Direction Model - cos^2

Page Motion Models

Write general purpose information for motion models.

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Write Documentation for Ochi 2 Parameter Wave Spectra.

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Page Wave Frequencies

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