Wind Plugin Theory of Operation

1 Overview

The influence of wind on the motion of the USV is implemented as a simple model plugin for Gazebo. Currently there is only one implementation, but other implementations, with varying fidelity, could be developed in the future.

2 usv gazebo wind plugin

The wind forces (x and y) and moment (yaw) are predicted following the models presented by Fossen [1].

The wind velocity on the vessel (V_w) is considered to be a constant velocity and direction. If desired, this could be extended to include a parameterized wind spectrum the distribution of wind velocities over time, e.g., average wind velocity, gusts, etc. For the current implementation the constant wind velocity is specified as a three element vector which specifies the wind speed the world-frame x, y and z coordinates with units of m/s. The z component is ignored.

The resulting forces and moments on the vessel are determined based on the user-specified force/moment coefficients and the relative wind velocity. Within the plugin, the relative (or apparent) wind velocity vector V_R. The forces/moment are calculated as

$$
\begin{align}
X_{wind} &= C_X V_{R_x} |V_{R_x}| \tag{1}\\
Y_{wind} &= C_Y V_{R_y} |V_{R_y}| \tag{2}\\
N_{wind} &= -2.0 C_N V_{R_x} V_{R_y} \tag{3}\\
&\tag{4}
\end{align}
$$

where C_X, C_Y and C_N are specified as the three element `wind_coeff_vector`. Approximate values for these coefficients are given in [2] which can then be tuned to give reasonable response.

References

[1] T. I. Fossen, *Guidance and Control of Ocean Vehicles*. Wiley, 1994.

[2] E. I. Sarda, H. Qu, I. R. Bertaska, and K. D. von Ellenrieder, "Station-keeping control of an unmanned surface vehicle exposed to current and wind disturbances," *Ocean Engineering*, vol. 127, pp. 305 – 324, 2016.