Design description of the controllers

Rev 0.1.0

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Contents

1 Autopilot

There are two parameters to control during autopilot: surge speed and heading.

1.1 Heading

The heading of the vessel in autopilot is currently controlled by a PID controller.

1.1.1 PID

The basic equation for the PID controller can be written as

$$\tau_\psi = K_p \cdot e + K_i \cdot \int e + K_d \cdot \dot{e} \tag{1}$$

where τ_ψ is wanted heading force, K_p is the proportional gain, K_i is the integral gain and K_d is the derivative gain. e is the error and is defined as

$$e = \psi_d - \psi \tag{2}$$

where ψ_d is the desired heading.

Anti-windup The I-term can increase to very large or decrease to very small numbers. This will cause significant overshoot when reaching the setpoint during a heading change, for example. A couple of mechanisms are implemented to prevent the I-term from winding up.

- The I-term doesn't start building up unless the vessel's heading is within a sector of the desired heading. This sector is set in Controller.json and goes to both positive and negative direction around the desired heading.
- The I-term can never go above a value given in Controller.json.
- The I-term starts building down when within iDieSector (close to the desired heading). It goes to zero with a constant of iDieConstant per second.

1.2 Speed

1.2.1 PID