ABSTRACT

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This dissertation considers the trajectory control problem of a surface marine vessel for its dynamic positioning with the tracking of a prespecified trajectory under the action of unknown environmental disturbances. The dynamic model of the system and its properties are developed to allow the control design. The vessel dynamics is nonlinear, thus, feedback linearization was implemented to remove nonlinearities and facilitate the application of controllers. Four controls for trajectory tracking have been considered. The first controller was the Proportional-Derivative (PD), that is a widely used controller and is of easy implementation. The second controller was the Proportional-Integral-Derivative (PID) controller which is also easy to implement and has an integral action that mitigates the residual error present in the PD controller. The third is a Sliding Mode Control (SMC). An advantage over previous controllers is that the SMC is superior in relation to disturbance rejection, is robust to parameter variation and has a simple implementation. The Unit Vector SMC (UVC) was implemented, which is convenient for multivariable systems. The fourth controller is an Adaptive SMC. It allows trajectory tracking without the knowledge of the amplitude of environmental disturbances. Using the equivalent approximated averaging filters allows the disturbances to be estimated from low-frequency components of the control signal. Simulations of the disturbances and controllers for trajectory tracking presented in this Dissertation allow a fair comparison of these strategies.

Keywords: Surface vessel. Trajectory tracking. Sliding-mode control. Adaptive control. Feedback linearization.