Modelling and control of a piezo actuated micro robot with active force control capability for in-pipe application

Abstract:

In this paper, a piezo actuated micro robot with active force control (AFC) capability is modelled and simulated for an in-pipe application. A mathematical model that describes the dynamic characteristics of the micro robot is first presented. The dynamic response of the robot system subjected to different input excitations is then investigated by initially considering a conventional proportional-integral-derivative (PID) controller to perform a trajectory tacking task. Subsequently, a robust AFC-based controller is serially added to the PID controller, the primary aim of which is to reject the unwanted disturbances due to frictional forces in the pipe. The control system is tuned so that an accurate trajectory tracking control is achieved. The performance of the control system under different loading and operating conditions is evaluated through a rigorous simulation study. A sliding mode controller (SMC) was also included to provide another means of comparing the system performances apart from the pure PID control scheme. The obtained results clearly demonstrate the robust trajectory tracking performance of the proposed AFC-based micro robot system in spite of the negative effects of the external disturbances.