Public Abstract

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Title:Design of an Efficient Controller for Arterial Oxygen Saturation in Neonatal Infants.

A main problems for premature infants is respiratory distress syndrome (IRDS), also called neonatal respiratory distress syndrome, or respiratory distress syndrome of newborn. Due to IRDS, the infant requires intervention in the form of respiratory support to increase the inspired oxygen. Physicians must keep the range of the Arterial Oxygen Saturation (SpO_2) between 82 – 95% to help the premature infants to get oxygen enough while preventing other complications. If the blood oxygen saturation is more than 95% or less than 82%, the infant is at risk for retinopathy of prematurity. The control is analyzed using PI, PID, Model Predictive Controller (MPC), Robust control wit PID and Robust control with MPC to ensure stability and minimum settling time to reach the accuracy of output SpO_2 by applying the Fraction of Inspired Oxygen (FiO_2) as control action. MPC is an optimal control strategy based on numerical optimization by using a system model and optimizing at regular intervals. We can predict the future control inputs and future plant responses. An error model is created using the resulting ranges of system gains and time constant from [18]. The ?-synthesis controller is developed to control the oxygen percentage of inspired air and performance specifications are defined. The H_? method is used to determine the robust stability and robust performance are achieved with the system uncertainty that described by the error model. A comparison among a static proportional integral, proportional integral derivative, the model predictive controller, the robust controller with PID controller, and the robust controller with MPC found that the robust controller with MPC displays the best performance for a system with large ranges of model parameters. The results got from this dissertation are ; PI controller has large overshoots and large steady state error when using large values of K_I but when decreasing the values of K_I got good response with low overshoot and zero steady, PID controller has large overshoots and large steady state error when using large values of K_I and small values of K_p but when decreasing the values of K_I and increasing values of K_p got good response with low overshoot and zero steady, MPC controller has a zero steady state error and no peak overshoot and achieves SpO_2 to be a minimum settling time of 105 sec and zero steady state error, in robust control system based on the PID that showed the results of controller can guarantee stability and performance for whole range of model parameters and robust model predictive controller was analyzed, we did get the robust stability, nominal performance and robust performance. The robust controller is found to have a robust stability and performance, but with a low bandwidth frequency due to a conservative control design required to achieve robust stability with an extremely high level of model error. The main goal of the robust controller was analyzed for performance and stability. It was shown to be more nominally stable and have nominal performance and robust stability and performance. We showed that the result of controller can guarantee stability and performance for a whole range of model parameters. These results will help the respiratory infants to get alive in range of oxygen between 85% - 94%. It is very important to alleviate the workload of nurses in an intensive care unit when this controller is used to reduce the time and amount of harmful desaturation events