**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI**
**SHORT ABSTRACT OF THESIS**

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Thesis Title: IDENTIFICATION SCHEMES FOR MODELLING OF DEAD TIME PROCESSES: A LIMIT CYCLE APPROACH

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## SHORT ABSTRACT

This thesis proposes various identification strategies in the framework of relay control systems followed by the development of explicit expressions for transfer function modelling of dead time processes using limit cycle information. Time delays (or dead times) appear in many processes associated with various industries such as process control, network control, biological control, etc. Using a relay feedback experiment, the characteristics of unknown processes are captured in the form of sustained oscillatory responses, known as limit cycle. Important information from limit cycle at the process output is measured and thereafter substituted in a deduced set of mathematical expressions for the identification of time delay processes.

Initially, attempts have been made to represent the industrial process dynamics in terms of linear transfer function models with time delay using frequency domain methods. However, due to the involvement of approximation in the equivalent gain of relay, such frequency domain based mathematical expressions yield erroneous industrial plant transfer function models and may lead to an inefficient controller design, which is not desirable. Therefore, to obtain better accuracy in the estimation of process model parameters, a state space approach is adopted and an explicit set of mathematical expressions are derived for identification of time delay processes using limit cycle information. Thereafter, the proposed approach is extended for modelling and identification of non-minimum phase processes with time delay. From the identified models of stable, unstable and integrating processes, the model based controllers are designed. Tuning rules for choice of proportional and integral gains have been presented which are aimed at maintaining a balance between either of them to achieve improved output transient performance.

In addition, the conventional relay feedback experiment has been modified to meet practical requirements and the obtained limit cycle information is further substituted in the modified set of mathematical expressions for the identification of a class of industrial plants. The proposed relay feedback configuration helps in the generation of sustained oscillations around the setpoint. Benchmark examples from literature are considered for simulation and experimental results from laboratory prototypes of the level control system and coupled tanks system are included to show the validation of the proposed relay based identification methods. Finally, comparisons of identified and actual plant models are made to demonstrate the superiority of the proposed identification algorithms.