بسم الله الرحمن الرحيم

In the Name of Allah,
the Compassionate, the Merciful,

THE EFFECTS OF ANTI-ALIASING FILTERS ON SYSTEM IDENTIFICATION

A thesis presented in partial fulfilment of the requirements for the degree of Master of Technology in Production Technology Department at Massey University.

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AIMS and OBJECTIVES of the PROJECT

Keywords: System identification, Simulation, Anti-aliasing filtering.

In order to satisfy the Nyquest criterion for sampling, signals must be band limited. This is usually achieved by using low pass analog filters which must be placed before sampling (these filters are called anti-aliasing filters). These filters have some effect on the identification of systems. The aim of this project was to determine these effects.

The objectives were to:

1) Choose systems with different natural frequencies
2) Simulate these systems
3) Apply a PRBS (Pseudo Random Binary Sequence) input and log the output
4) Sample this data
5) Transfer sampled data to MATLAB
6) Find the best model using the MATLAB identification toolbox
7) Simulate the filters
8) Pass the output data through these filters

9) Repeat (5) and (6)

10) Simulate additive measurement noise

11) Add noise to the output of the system

12) Repeat (8) and (9)

13) Compare the real data with model data

14) Calculate the error criterion (J) for each case

Finally, a suitable parameter was to be identified which could be used to design effective anti-aliasing filters.

SUMMARY

Research was conducted to determine the effect of anti-aliasing filters on the identification of dynamic systems. Systems were simulated in the continuous simulation package ESL. The system response to a PRBS (Pseudo Random Binary Sequence) was recorded. Simulated noise was added and passed through a number of simulated analog filters. The systems were identified using the MATLAB identification toolbox.

Two standard filters (Butterworth and Chebychev) were used with cut-off frequencies between ω_s (natural frequency of the system) and 20 times ω_s.

Results showed that carefully designed filters could improve the performance of the identification algorithm in the presence of non-white high frequency additive noise. However for noise free measurements the filters degraded the performance of identification algorithms. This performance could be observed in the identified models steady state error, overshoot and settling time when subject to a step input.

In the experiments performed, the lowest order (and in one case second order) filters with cut-off frequency of $\omega_n \cong 5\omega_s$, gave the best results.