Chapter 9

Conclusion and Future Scope

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CONCLUSiON & Scope for future Expansion

The techniques developed are powerful to the field of disturbances rejection. Using these new techniques disturbances caused either by unknown inputs, plant perturbations or actuator faults can be estimated and accommodated. The integral action approach, using variants of the PI observer, provide accurate disturbance estimate that allow for the accommodation and identification of disturbances given: the injection points of the disturbances; at least one independent state measurement for each disturbance and disturbances with time constants longer than the time constant of the plant. Qualitative Robust Control (QRC), shows that controllers built using qualitative models and behaviors are as effective at accommodating disturbances as controllers built using H_2 and H_∞ techniques. The QRC controller requires only a small set of simple linguistic rule, with all parameters having simple interpretations, to achieve the same level performance as the H_2 and H_∞ controllers built with complex mathematical constructs, and using obscure parameters.

Further works needs to be performed in characterizing the stability of the PI, PFI and Neuro-fuzzy observers with respect to a given set of disturbances. Augmentation of the estimation equation with both the model of the disturbance and the integral action will allow the optimal integral gain for a set of disturbances to be derived using the solutions to the resulting algebraic Riccatti equation.

Design techniques for an adaptive H^∞ Controller are described in chapter 7 uses Ridge Gaussian Neural Networks Since small approximation errors may affect the tracking performance significantly H^∞ control theory may be used to attenuate the effects of the approximation errors of the ridge Gaussian neural networks to a prescribed level. The values of the network parameters, after sufficient training, are then utilized to generate If-Then rules on the basis of pre selected meaningful features.

Fuzzy observer design methods are discussed in brief. This observer may be used to compensate the load disturbance that makes the position inaccuracy. It can be linked with ANN and Optimization techniques for more accuracy.

The suitability of the artificial neural network methodology for solving some process engineering problems is discussed. ANN may be used to provide estimates of difficult to measure quality variables or industrial data. Measurements from established instruments are may be used as secondary variables for estimation of the primary quality variables. ANN can also be used directly within a model-based predictive control strategy. The prediction based on fuzzy model the form of Takagi–Sugeno (T–S) type may be attempted. Application-specific extensions for fuzzy processing to a general purpose processor may be developed. The application-specific instruction set extensions can be defined and evaluated using hardware/software code sign techniques. A fuzzy or

ANN processor can be designed for hardware solution or designing embedded controllers employing soft computing methods and parallel processing algorithms.

A summary of the literature on schemes for speed sensor less drives has been given summarized in chapter 7. The trends and tradeoffs of the different speed sensor less schemes are discussed. Further research areas needed in each scheme are noted. Although a number of schemes have been proposed for solving the speed estimation, many factors remain important in comparing their effectiveness. Among these factors are the wide speed range capability, motor parameter insensitivity and noise reduction.

In particular, zero-speed vector control with robustness against parameter variations yet remains an area of research for speed sensorless control. Future work on induction motor drive based electrical actuators should develop a speed sensor less scheme that will investigate and effectively incorporate the above factors, it is expected to yield more reliable, high performance and cost-effective electrical actuators which will benefit thrust vector control of launch vehicles and aircraft upgrade.

Many factors are important in comparing the effectiveness of a speed sensor less scheme. Among them are the wide speed range capability, motor parameter insensitivity and noise reduction. Although a number of schemes have been proposed for solving the speed estimation, zero-speed FOC with robustness against parameter variations still remains an area of research for speed sensor less control.

Design approaches to hybrid control systems combining conventional control techniques with fuzzy logic and neural networks. Such a mixed implementation leads to a more effective control design with improved system performance and robustness. While conventional control allows different design objectives such as steady state and transient characteristics of the closed loop system to be specified, fuzzy logic and neural networks are integrated to overcome the problems with uncertainties in the plant parameters and structure encountered in the classical model-based design. Induction motors are characterized by complex, highly non-linear and time-varying dynamics and inaccessibility of some states and outputs for measurements, and hence can be considered as a challenging engineering problem.

The advent of vector control techniques has partially solved induction motor control problems, because they are sensitive to drive parameter variations and performance may deteriorate if conventional controllers are used. Fuzzy logic and neural network-based controllers are considered as potential candidates for such an application. Control approaches are developed and applied to adjust the speed of the drive system. Using fuzzy logic concept, neural networks and with a fuzzy state feedback controller may be developed based on the pole placement technique. A simulation study of these methods is presented. The effectiveness of these controllers is demonstrated for different operating conditions of the drive system.

Speed estimation method of an induction motor using neural networks (NNs) is presented. The NN speed estimator is trained online by using the error back propagation algorithm, and the training starts simultaneously with the induction motor working. The estimated speed is then fed back in the speed control loop, and the speed-sensorless vector drive is realized. The validity and the usefulness may be thoroughly verified with experiments on fully digitalized 2.2-kW induction motor drive systems.

Direct torque control (DTC) system is currently one of the favorable control schemes for ac motor drives since it has the important advantage that system performance is not dependent on the motor parameters except the stator resistance. However, if the stator resistance varies due to heating, the performance of the system will suffer if the stator resistance value used in calculating the stator flux does not match the actual one. The compensation for the effect of the variation of stator resistance then becomes necessary. A fuzzy observer is described, which can estimate the stator resistance on-line, according to the actual stator current, motor speed and operation time is applicable to any type of motor drive systems

The fuzzy-logic speed controller is employed in the outer loop. The complete vector control scheme of the IM drive incorporating the FLC is experimentally implemented using a digital signal processor board DSK 28XX series of processor for the laboratory 1-hp squirrel-cage IM.

A modular Simulink model for induction machine simulation has been simulated in Chapter 8. Unlike most other induction machine model implementations, with this model, the user has access to all the internal variables for getting an insight into the machine operation. Any machine control algorithm can be simulated in the SIMULINK environment with this model without actually using estimators. If need be, when the estimators are developed, they can be verified using the signals in the machine model. The case of implementing controls with this model is also demonstrated with several examples. Finally, the operation of the model to simulate both induction motors and generators has been shown so that there is no need for different models for different applications.
Neuro-computing is fast compared to conventional computing because of massive parallel computation. Besides, it has the properties of fault tolerance and noise filtering. Here neural network is used as if estimator. Neural network-based control strictly does not need a mathematical model of a plant like a conventional control method does with the required precision.

Modular model can be simulated for the slip power recovery with the slip gain tunning by model referencing adaptive control principle. Also model can be simulated for scheribus drive with slight modification.

Neural network setup or architecture it can be made for the physical system. By converting *.mdl (model file) file into the c code file using real time workshop giving a code operated by the DSP kit. PWM output DSP kit can be directly applied to the motor to run for the real time. To make it closed loop rotor speed is feedback to the DSP kit.

The design and simulation of a robust adaptive observer is described. The robust adaptive observer is used for training the neural network to generate feed back signal estimate. The generated NN block is used for closed loop current control of induction motor within permissible range. GUI design for speed control of induction motor is implemented, which allows the user to change the parameter of induction motor, to select Robust or Non-robust (Kalman Filtering) operation, to initialize and run simulation model to generate training pairs. Generated ANN block for new parameters can be used as a library block for the SIMULINK models in a speed control application.

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