Adaptive Interconnected Observer-Based Backstepping Control Design For Sensorless PMSM

In this paper, a robust sensorless speed observer-controller scheme for a surface permanent magnet synchronous motor (SPMSM) is proposed. First-of-all, following preliminary results in the framework of the induction motor that is less sensible to the position estimation error, an adaptive high gain interconnected observer is designed. It is only supplied by the electrical measurement: the motor currents and voltages. This observer estimates the rotor speed and position, the stator resistance and the load torque. A non linear backstepping controller is developed. The above observer is associated to this controller and the complete scheme practical stability proof is given. The overall system is tested by simulation in the framework of an industrial benchmark with a trajectory that particularly checks the motor unobservability condition. Some robustness tests have been carried out. The controller-observer scheme shows good performances in spite of the uncertainties and the unknown load torque.

Sensorless digital control for switched reluctance motor

Recently, a great interest has been directed to switched reluctance motor and its wide applications in industry; such as: robotics, textiles, servo-drives, domestic drives and electric vehicles. The earliest control techniques used for SRMs were difficult and complicated due to their requirements for rotor position sensor. The rotor position sensor is a significant contribution to the cost and complexity, and tends to reduce the reliability of the drive system.

In this paper, a simplified sensorless digital controller has been designed, analyzed, implemented and tested with SRM of 6/4 pole and 1.1 kW rated power. Moreover, a digital simulation of the SRM supplied from this controller has been developed using MATLAB/SIMULINK program. Some interested measured results have been introduced to illustrate the performance characteristics of the system. Finally, both practical measured results and theoretically calculated results were compared and found much close to each other.

Comparaison de deux observateurs non linéaires pour la commande sans capteur de la MSAP : validation expérimentale

Dans cet article, aprè s une analyse de l’observabilité de la machine synchrone à aimants permanents, les lisses, deux observateurs robustes de type modes glissants sont comparés pour la reconstruction de
Sensorless Speed Control of Permanent Magnet Synchronous Motor by using Sliding Mode Observer

This paper presents a sensorless speed control for a permanent magnet synchronous motor (PMSM) combining a robust backstepping controller and a sliding mode observer based on the super twisting algorithm. Firstly, the structural property of the observability of this machine is analyzed. Then, an observer is designed in order to estimate the speed and the position of the machine from the only measurement of the currents and the voltages. A robust backstepping controller is then designed in order to track a desired speed reference under uncertainties and unmodeled dynamics. The result is obtained in spite of uncertainties in the stator resistance and stator inductance, which usually are bad known and timevarying. Simulation results are shown in the framework of an industrial benchmark to illustrate the performance of the proposed scheme with the critical case of standstill and low speed.

Sensorless high order sliding mode control of permanent magnet synchronous motor

In this paper, a robust sensorless speed observer controller scheme for a permanent magnet synchronous motor (PMSM) is proposed. To estimate both position and speed, without any mechanical sensors and only from the electrical measurements, a back-EMF-based sliding mode is designed. The convergence of this observer is proved. Then a high order sliding mode controller is developed. By using this technique, the drawback of the sliding mode technique called "chattering phenomenon" is strongly attenuated. After that, the convergence of the overall system is analyzed. Moreover, the robustness of this method with respect to the parameters uncertainties is verified by significant simulation results in the framework of an industrial benchmark.
6- Sensorless speed control of a permanent magnet synchronous motor: high order sliding mode controller and sliding mode observer

In this paper, a robust sensorless speed observer-controller scheme for a permanent magnet synchronous motor (PMSM) is proposed. First-of-all, the observability of the PMSM is studied and fixed for the surface permanent magnet synchronous motor (SPMSM). Secondly, a complete model observer based on sliding mode technique in order to estimate both position and speed is designed. Then, a high order sliding mode controller is developed. By using this technique, the well-known “chattering” phenomenon is highly attenuated. The stability and the robustness of the controller-observer scheme are proved. The overall system is tested by simulation with significant tests of robustness in the framework of an industrial benchmark.

7- Observer-Controller Scheme using High Order Sliding Mode Techniques for Sensorless Speed Control of Permanent Magnet Synchronous Motor

This paper deals with the control problem of the speed for a sensorless permanent magnet synchronous motor (PMSM) using high order sliding mode techniques. An observer is designed via a super twisting algorithm in order to estimate the speed and the position of the motor from the currents and the voltages measurements. A quasi-continuous high order sliding mode controller is designed in order to the speed tracks a desired reference under the presence of parameter uncertainties. Simulation results are shown in the framework of an industrial benchmark to illustrate the performance of the proposed scheme. The results are obtained in spite of parameter uncertainties on stator resistance and stator inductance that are bad known.

8- Sensorless speed control of PMSM via adaptive interconnected observer

In this article, a robust sensorless speed observer-controller scheme for a surface permanent magnet synchronous motor (PMSM) is proposed. First-of-all, following preliminary results in the framework of the induction motor that is less sensible to the position estimation error, an adaptive high gain interconnected observer is designed. It is only supplied by the electrical measurement: the motor currents and voltages. This observer estimates the rotor speed and position, the stator resistance and the load torque. A nonlinear backstepping controller is developed. The above observer is associated with this controller and the complete scheme practical stability proof is given. The overall
system is tested by simulation in the framework of an industrial benchmark with a trajectory that particularly checks the motor unobservability condition. Some robustness tests have been carried out. The controller–observer scheme shows good performances in spite of the uncertainties and the unknown load.