ECSA-12 2025 Conference

The 12th International Electronic Conference on Sensors and Applications

12–14 November 2025 | Online

MDPI

Impact of Position Sensor Faults on the Control Performance of PMSM Drives

Slimane Medjmadj

Department of Electrical Engineering, Faculty of Science and Technology,

University Mohamed El Bachir El Ibrahimi of Bordj Bou Arreridj.

ETA Laboratory, University Mohamed El Bachir El Ibrahimi of Bordj Bou Arreridj, Algeria.

INTRODUCTION & AIM

•High-performance control of Permanent Magnet Synchronous Motors (PMSMs) relies heavily on accurate rotor position and speed information, typically provided by rotary sensors such as resolvers, incremental encoders, or absolute encoders. This information is essential for transforming stator currents into torque and flux components, thereby enabling efficient motor control. However, system performance can degrade significantly when sensor faults occur, such as signal loss, drift, or voltage-induced deviations.

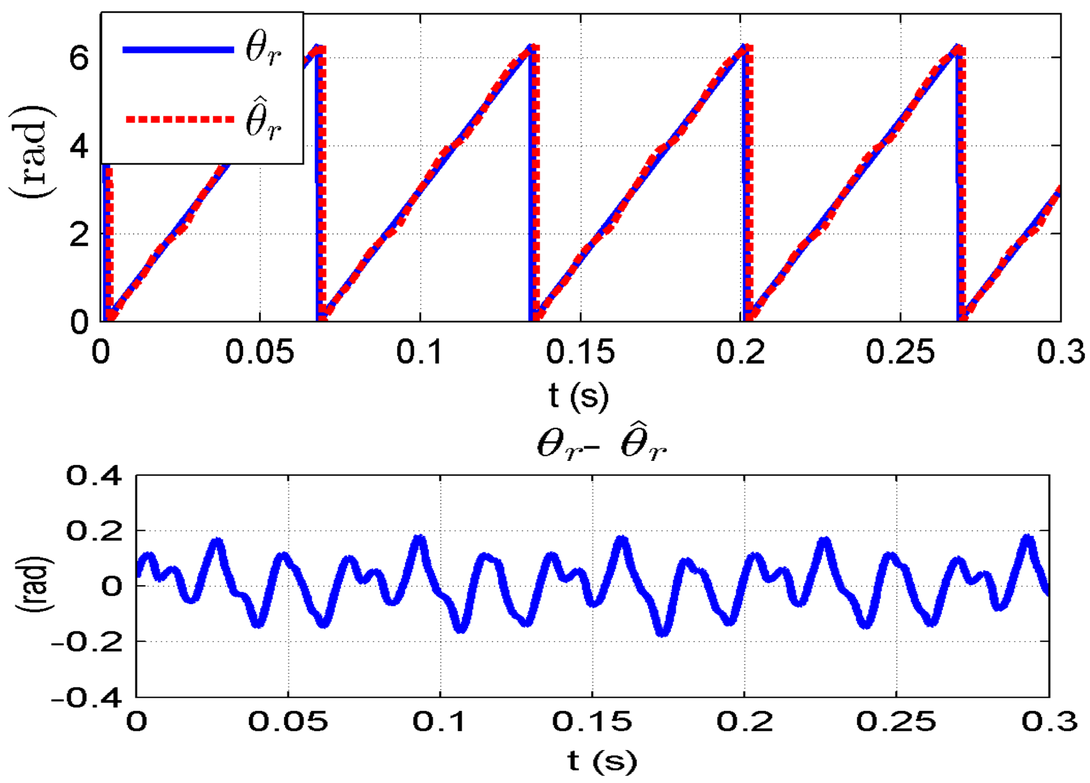
•One effective solution for diagnosing position/speed sensor faults is estimation techniques. As a software-based approach, estimation serves as a reliable backup to reduce risks associated with mechanical sensor failures (complete outage, drift, etc.). Moreover, such methods pave the way for developing new sensorless control strategies, eliminating the dependence on physical position/speed sensors. sensor.

METHOD

The position estimation is derived from a high frequency current injection by using three filters (a low-pass Filter (LPF) a high pass filter (HPF) and a band pass-filter (BPF). The most common approach is to superimpose a HF voltage carrier on the fundamental voltage supply. The rotor position is then extracted from the resulting HF current components. The frequency of the injected voltage carrier, wi, should be high enough to ensure sufficient spectral separation between the excitation and the fundamental supply to reduce the requirements of the band-pass filter.

RESULTS & DISCUSSION

The position/speed estimator output is now used for the control and the position sensor output is used solely for comparison purpose. This figure shows the performances of the estimator in sensorless operation in the very low speed range.



Actual, estimated and errors rotor position

To conclude, the position errors (inferior to 0.2 electrical radians in steady state corresponding to 3 mechanical degrees) are in the acceptable ranges for automobile applications, which target generally a 5% position error (0.31 electrical radians).

CONCLUSION

The main contributions as follows: Development of a simple method for position and speed estimation at very low speed. For implementation issues, the method is also cost effective in terms of execution time and robust to parameter variations.

FUTURE WORK / REFERENCES

[1] A.O Salau , T.M Anteneh , "Direct Quadrate Modeling of a Direct Torque Control for a 3-Phase Induction Motor" , (ISPCC), pp. 522-527. DOI: 10.1109/ISPCC53510.2021.9609480, 2021.

[2] A.W Yesgat, A.O Salau , H.E Kasshun, "Fuzzy Based Sliding Mode Control of Vector controlled Multiphase Induction Motor Drive under Load Fluctuation", Journal of Electrical and Electronics Engineering ; Oradea, Vol. 15, N° 2, pp.98-105, 2022.