

Experimental Evaluation of the IEC 61800-9-2:2023 Standard Applied to Advanced Variable-Speed Drive Systems Based on PMA-SynRM

Bartolomeu Kapalandanda, Fernando Bento and Antonio J. Marques Cardoso
CISE - Electromechatronic Systems Research Centre

University of Beira Interior, Calçada Fonte do Lameiro, P – 6201-001 Covilhã, Portugal
(email: bartolomeu.kapalandanda@ubi.pt; fjbento@ieee.org; ajmcardoso@ieee.org)



INTRODUCTION

Electric motors account for around 65% of global industrial electricity consumption, a figure exacerbated by widespread motor oversizing and inefficient flow control methodologies. To mitigate these losses, high efficiency motors and Variable Frequency Drives (VFDs) emerged as a key strategies for energy optimization. However, their widespread adoption relies on robust standardized evaluation procedures. The IEC 61800-9-2:2023 standard establishes testing frameworks and efficiency classifications for Power Drive Systems (PDS). Despite its importance, its applicability to advanced synchronous motors technologies, particularly under realistic industrial load profiles and harsh conditions remains insufficiently validated, highlighting the need for further experimental assessment [1], [2], [3].

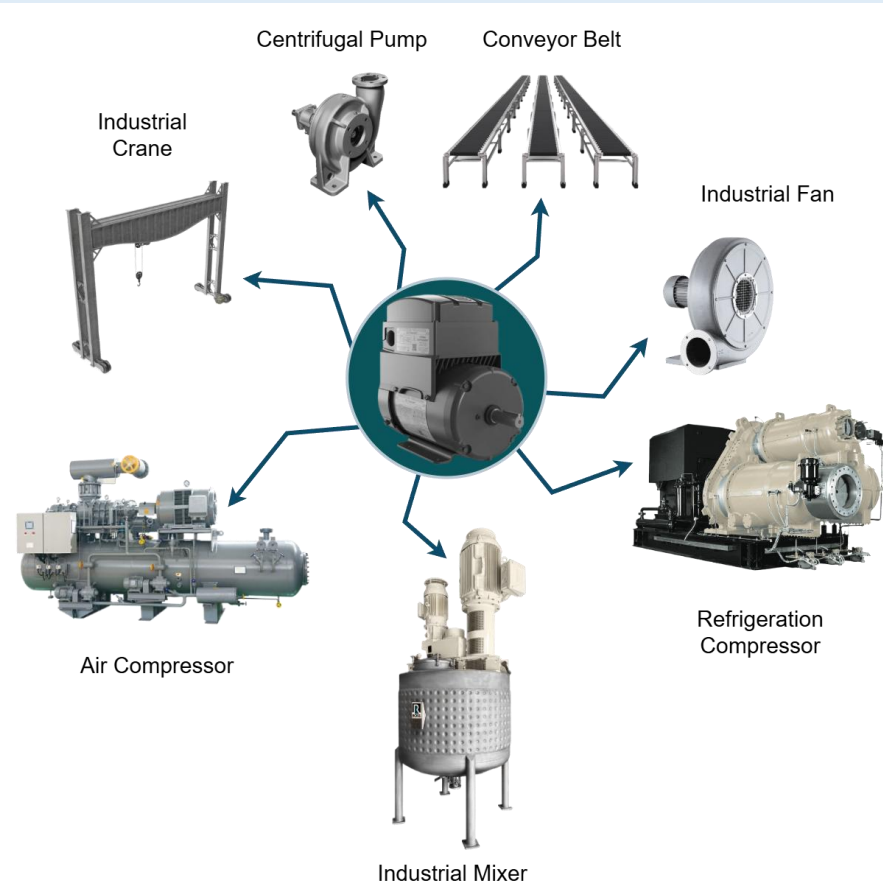


Figure 1 – Electric motor applications

EXPERIMENTAL SETUP & RESULTS

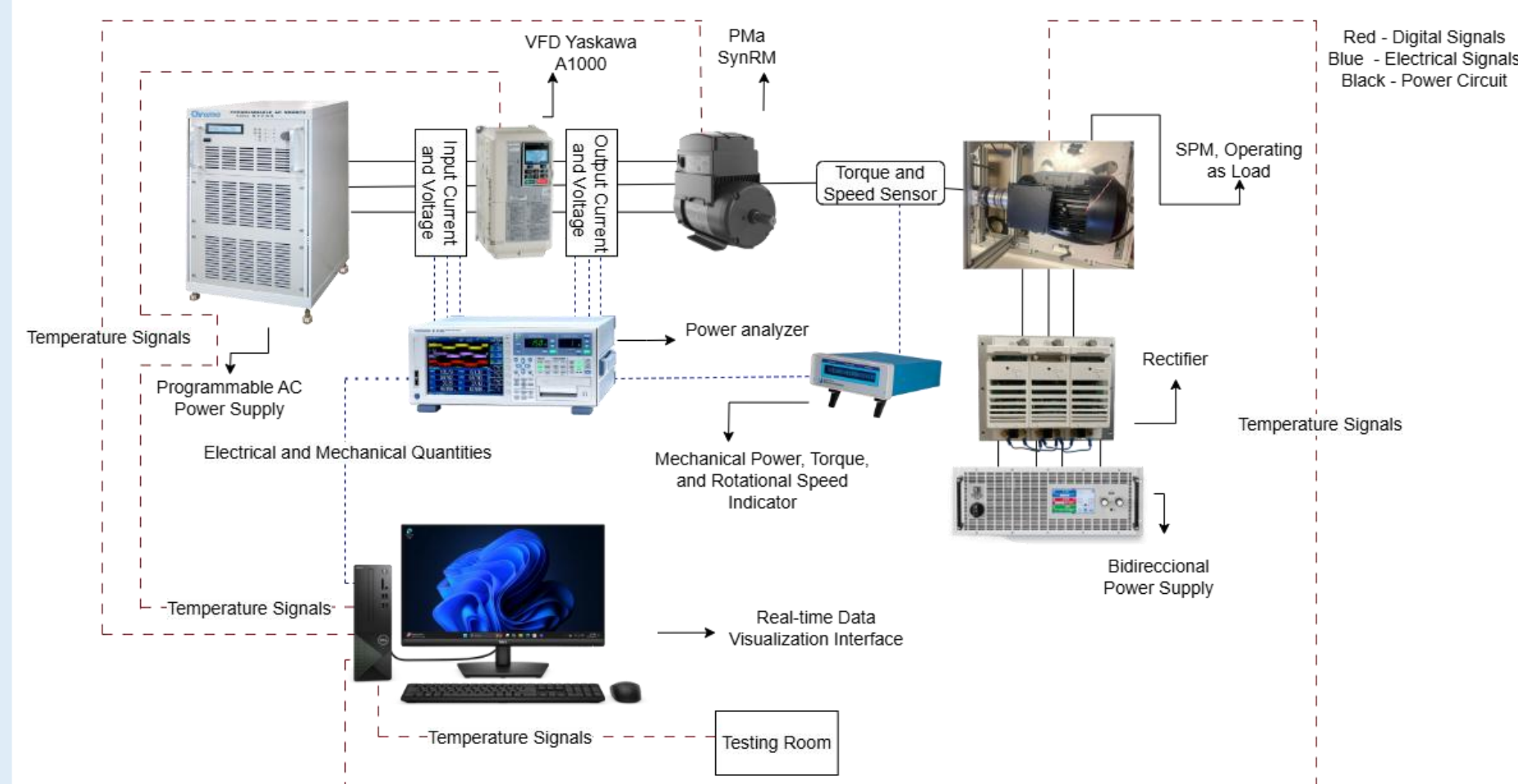


Figure 3 – Experimental setup for test the Power Drive system

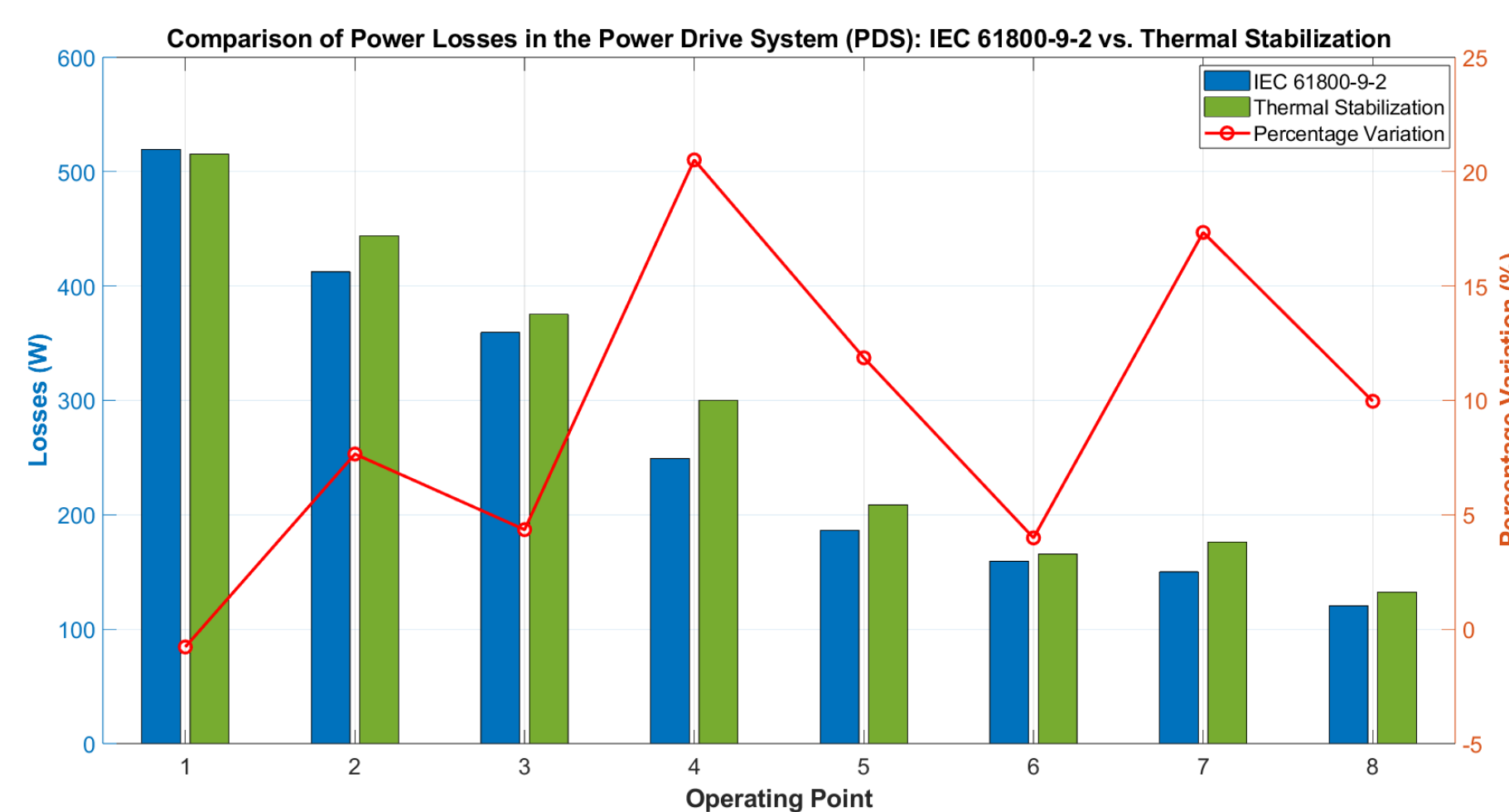


Figure 4 – Comparison of Power Drive system (PDS) losses: IEC 61800-9-2:2023 vs. thermal stabilization

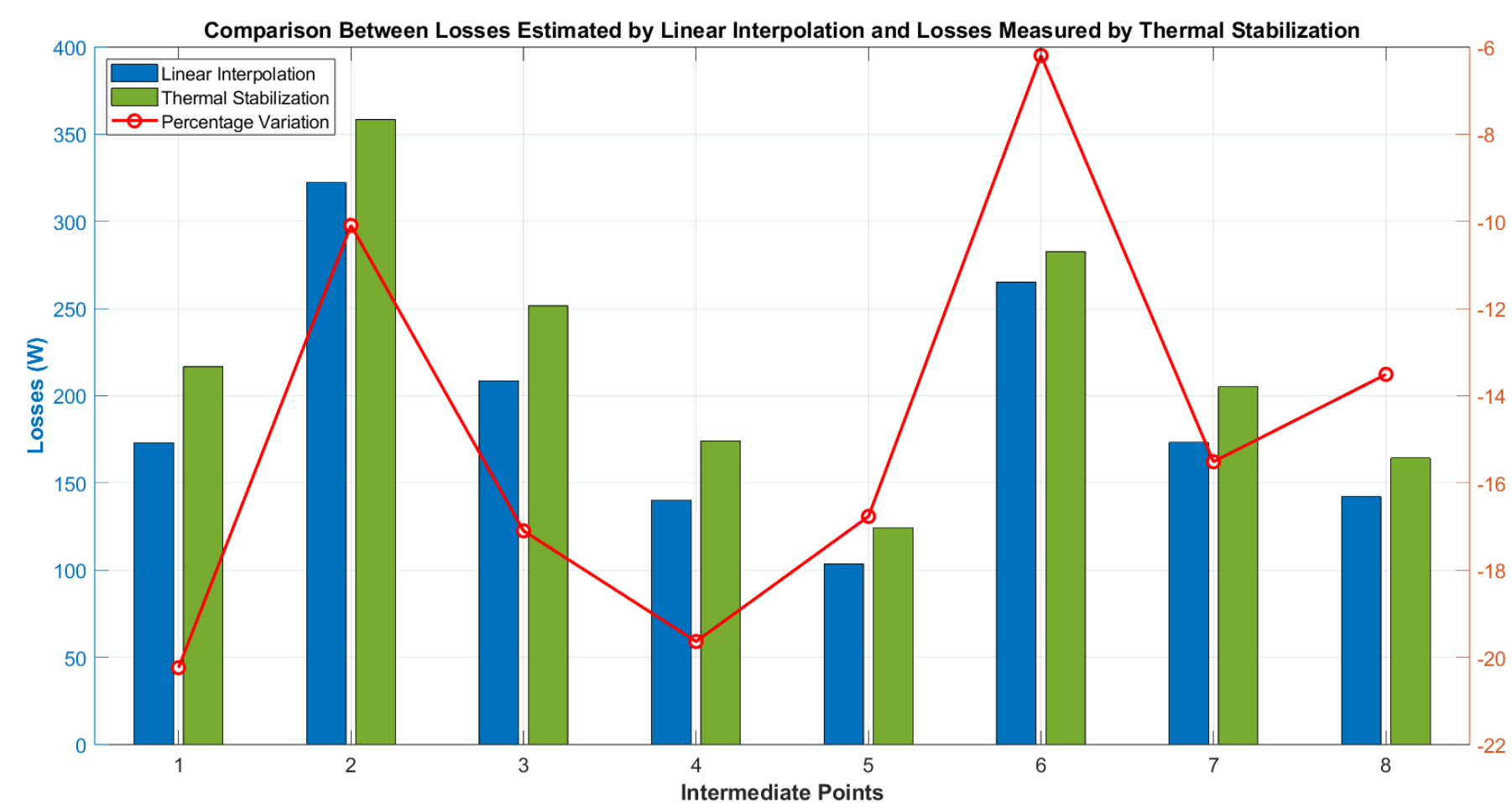


Figure 5 – Comparison of Power Drive system (PDS) losses: linear interpolation vs. measured losses under thermal stabilization.

METHODS [4]

- IEC 61800-9-2:2023 testing procedure
- Thermal stabilization method
- Experimental setup:
 - PMA-SynRM (7.5 kW)
 - Yaskawa A1000 VFD
- Evaluation at 8 standardized operating points.

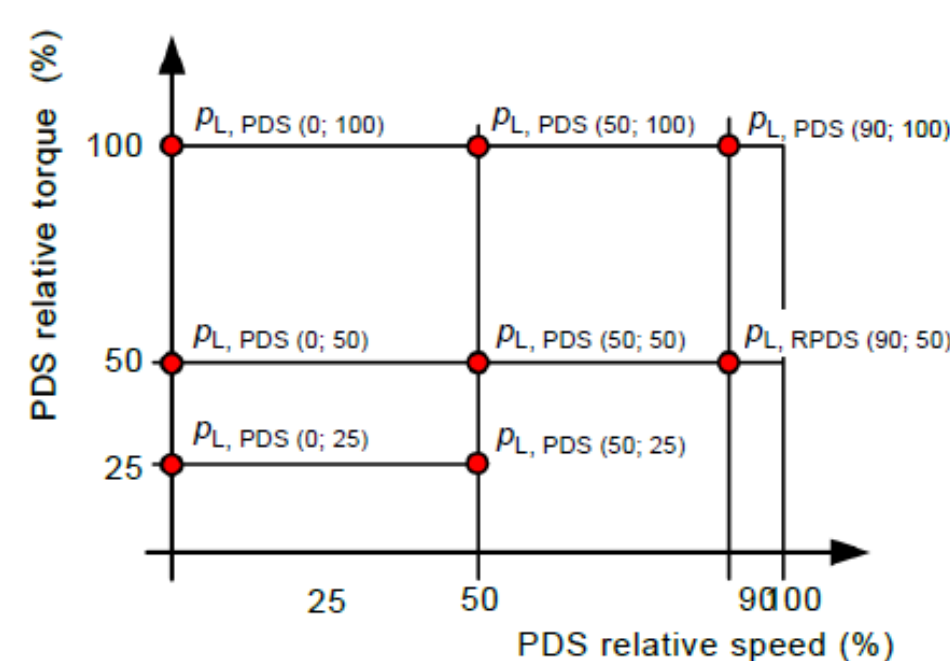


Figure 2 – Eight operating standardized points

DISCUSSION

The methodology prescribed IEC 61800-9-2:2023 exhibits systematic deviations when compared with experimental thermal stabilization results. Specifically, the standard tends to overestimate losses, under partial load conditions. This discrepancy arises because normative framework is predominantly based on the physical behavior of induction motors, which fails to account for the electromagnetic non-linearities and thermal profiles of PMA-SynRM. Such limitations may lead to misclassification of system efficiency (IES classes), potentially driving suboptimal technology selection in industrial projects and incurring to unjustified capital and operational expenditures.

CONCLUSIONS

The current normative framework is foundational but incomplete for evaluating next-generation PDS, as experimental results reveal 20% divergence from thermal stabilization under partial load. A methodological refinement of the IEC interpolation models is also important, because rigorous validations remain essential for accurately characterizing emerging motor technologies.

REFERENCES

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- [3] J. Fong, F. J. T. E. Ferreira, A. M. Silva, and A. T. De Almeida, "IEC61800-9 System Standards as a Tool to Boost the Efficiency of Electric Motor Driven Systems Worldwide," *Inventions*, vol. 5, no. 2, p. 20, May 2020, doi: 10.3390/inventions5020020.
- [4] Adjustable speed electrical power drive systems – Part 9-2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications – Energy efficiency indicators for power drive systems and motor starters, IEC Standard 61800-9-2:2023, 2023.