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Robust Power-Electronic-Converter-Fault Detection and Isolation Technique for DFIG Wind Turbines

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Abstract - This work proposes a robust fault detection and isolation (FDI) technique for power electronic converters (PECs) operating doubly fed induction generators in wind turbines. More precisely, a diagnosis system able to detect and isolate open-switch faults is developed. It combines fault indicators based on the Clarke transformation of the converter currents and a statistical change detection algorithm, namely a cumulative sum (CUSUM) algorithm, that detects significant changes in the variance of the stator reactive power. This allows a reduction of the false alarm rate compared to an approach relying exclusively on the current analysis. The performance of the FDI technique is verified by both simulation and experimental studies.

Introduction

- According to statistical data, PECs are responsible for 25% of the total failures and 14% of the total downtime in WTs [1].
- This work aims to present a novel robust FDI technique that combines a statistical approach based on the CUSUM algorithm to detect the fault and the signal-based technique Clarke-transformation to isolate the fault.

Proposed Diagnostic Method

1. CUSUM Algorithm – Fault Detection

   • The CUSUM FDI algorithm will evaluate the changing in the stator reactive power variance [2]

\[ S(k) = \sum_{n=1}^{k} \ln \frac{p_{\mu_k}(z(t))}{p_{\mu_0}(z(t))} \]

   - \( E_{\mu_0}(s) < 0 \)
   - \( E_{\mu_1}(s) > 0 \)

\[ g(k) = S(k) - \min_{1 \leq j \leq k} S(j) \]

2. Clarke Transformation – Fault Isolation [3]

Simulation Results

Experimental Results

References

[1] - Qiao, Wei, and Dingguo Lu. "A survey on wind turbine condition monitoring and fault diagnosis - Part I: Components and subsystems." IEEE Transactions on Industrial Electronics 62.10 (2015): 6536-6545.

[2] - H. Zhao and L. Cheng. "Open-circuit faults diagnosis in back-to-back converters of DF wind turbine," in IET Renewable Power Generation, vol. 11, no. 4, pp. 417-424, 3 15 2017.

[3] - Blanke, M., Kinnaert, M., Lunze, J., Staroswiecki, M., & Schrder, J. (2006). Diagnosis and fault-tolerant control (Vol. 691). Berlin: springer.