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Optical fiber based quench detection in HTS applications using feature extraction on response signal

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A Mach-Zehnder Interferometer (MZI) based optical fiber sensing technique developed and patented by EPFL is an efficient and economical way to detect hotspots in HTS applications. Due to the MZI sensitivity being a composite of strain sensitive and temperature sensitive contributions, the MZI gives an instantaneous response to a quench (within 10 ms) resulting from the quick strain transfer to the optical fiber. However, the MZI output signal also manifests the environmental noise caused by mechanical vibrations, bubbling in the cryostat and temperature variations along with the response to the quench. This presents the problems of false alarms and indiscernible response to a quench. Discrete wavelet transform (DWT) has been proven to be a useful tool for feature extraction in different fields requiring signal categorization, and hence holds the potential to enable quench recognition in the MZI output. This paper proposes an effective approach of performing DWT based feature extraction on experimental data and subsequently using the extracted features for the MZI response classification. Feature extraction is implemented using discrete wavelet coefficients extracted at different decomposition levels to calculate statistical features useful for clustering and identifying quench in the MZI signal. This method could be a valuable supplement to the MZI technique by enabling the development of a real time application that can process the MZI output data as well as eliminate the occurrences of false alarms, thereby facilitating reliable quench detection. With this development, the MZI technique would become an even more attractive solution for the health monitoring of HTS applications.

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