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Signal Processing based leakage detection methods using passive fibre optic thermometry

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The development of early warning systems for the surveillance of earthen dikes confining the river flow is indispensable. Significant flow of water through the dike due to internal erosion is an important cause of breach and results in a thermal anomaly. The measurement of temperature is therefore capable of revealing information linked to leakage. Distributed temperature sensors (DTS) based on optical fibers present an economically viable solution for recording this temperature.

The spatio-temporal temperature data are influenced by several factors amongst them the leakages, the response of the near surface in which fiber is buried, the seasonal variations, the existing structures, the heterogeneities of the terrain, etc.

In order to remove temporal zones containing ephemeral energetic phenomena like precipitations which may generate false alarms during leakage detection, we propose a criterion based on higher order statistics.

Formulating leakage detection as a source separation problem, firstly, we present a system based on SVD and ICA for the separation of useful information relevant to the leakages from other "non relevant" factors.

Secondly, for the case when the number of acquisitions in time is limited, we propose a singularity detector exploiting the dissimilarity of daily temperature variations at different distances.

The proposed methods are validated on synthetic as well as real data acquired at experimental installations of EDF.