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(54) **ANOMALY DETECTION METHOD, PROGRAM, AND SYSTEM**

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(57) **ABSTRACT**

A method providing an analytical technique introducing label information into an anomaly detection model. Effective utilization of label information is based on introducing the degree of similarity between samples. Assuming, for example, there is a degree of similarity between normally labeled samples and no similarity between normally labeled and abnormally labeled samples. Also each sensor value is generated by the linear sum of a latent variable and a coefficient vector specific to each sensor. However, the magnitude of observation noise is formulated to vary according to the label information for the sensor values, and set so that normal label≤unlabeled≤anomalously labeled. A graph Laplacian is created based on the degree of similarity between samples, and determines the optimal linear transformation matrix according to a gradient method. A optimal linear transformation matrix is used to calculate an anomaly score for each sensor in the test samples.

9 Claims, 4 Drawing Sheets

Input: W, s_{normal}, $\mu=[\mu_1,...,\mu_D]$, $\sigma=[\sigma_1,...,\sigma_D]$ — 402

· Acquire (input) test data: $\{X' \in R^{N \times D}\}$
· Normalize X' in each column using μ and σ → X — 404

(Calculation of Anomaly Correlation Score:) — 406
Calculate anomaly score vector $s_n \in R^D$ for each row of X (sample)
$X_n = [X_{[n,1]} ... X_{[n,d]}]^T$ (anomaly score vector for each dimension = each variable = each sensor, higher = more anomalous):

$$s_n = s_0 + \frac{1}{2} \operatorname{diag}(\Lambda X_n X_n^T \Lambda B^{-1})$$

Where,

$$\Lambda = (W^T W + s_{normal}^2 I)^{-1}$$

$$B = \operatorname{diag}^2(\Lambda) \text{ and } (s_0)_i = \frac{1}{2} \ln \frac{2\pi}{\Lambda_{i,i}}$$

Output: Anomaly Scores $s_1, ..., s_N$ — 408