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An integrated generalized discriminant analysis method and chemical reaction support vector machine model (GDA-CRSVM) for bearing fault diagnosis

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ABSTRACT

An expert technique in bearing fault diagnosis is proposed for the identification of actual status. A new diagnosis method based on a two-stage hybrid modality in integrating generalized discriminant analysis (GDA) with the chemical reaction support vector machine (CRSVM) classification model, named GDA-CRSVM, is proposed. The GDA reduces high-dimensional data to a more compact data, which serves an optimized CRSVM classification model with input data, in which a support vector machine (SVM) classifier model with the best parameters are selected by the meta-heuristic chemical reaction optimization algorithm (CRO) to build an optimized CRSVM classification model. The implementation of the new proposed method is based on a multi-aspect feature (MAF) set that presents most of the actual aspects of the complex vibration signal. The MAF set is collected from the statistical features in time-domain, frequency-domain, and time-frequency domain features are extracted by local characteristic-scale decomposition (LCD). Experiments have been conducted on two bearing vibration datasets by the expert technique in the bearing fault diagnosis. Results shown that the effectiveness of GDA-CRSVM in terms of classification accuracy and execution time.

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Izvirni znanstveni članek

Integrirana splošna diskriminantna analitska metoda in model podpornih vektorjev, temelječih na optimizacijski metodi kemijske reakcije (GDA-CRSVM), za diagnozo napak na ležajih

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POVZETEK

V prispevku je predlagana ekspertna tehnika za diagnostiko napak ležajev in ugotavljanje njihovega dejanskega stanja. Predlagana diagnostična metoda GDA-CRSVM temelji na dvostopenjski hibridni modalnosti in integrira splošno diskriminantno analizo (GDA) ter klasifikacijski model, temelječ na optimizacijski metodi kemijske reakcije (CRSVM). GDA zmanjša podatke velikih dimenzij na bolj kompaktne podatke, ki služijo optimiziranemu klasifikacijskemu modelu CRSVM kot vhod. Najboljši parametri za izgradnjo optimiziranega CRSVM klasifikacijskega modela so izbrani s pomočjo modela klasifikacije podpornih vektorjev (SVM) ter metahevrističnega optimizacijskega modela, temelječega na optimizacijskem algoritmu kemijske reakcije (CRO). Prikazana uporaba predlagane metode temelji na večaspektni funkciji (MAF), ki predstavlja večino dejanskih vidikov kompleksnega vibracijskega signala. Nabor MAF je zbran iz statističnih lastnosti v časovnem, frekvenčnem in časovno-frekvenčnem področju z izločitvijo lastnosti z lokalno značilno-dimenzijsko dekompozicijo (LCD). Preizkusi so bili izvedeni na dveh podatkovnih nizih vibracij z ekspertno tehniko za diagnostiko napak. Rezultati so pokazali učinkovitost metode GDA-CRSVM z vidika natančnosti in časa izvedbe.

PODATKI O ČLANKU

Ključne besede:
Napaka ležaja;
Strokovna diagnostična tehnika;
Model podpornih vektorjev, temelječ na optimizacijski metodi kemijske reakcije (CRSVM);
Večaspektni nabor funkcij;
Splošna diskriminantna analiza (GDA)

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