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Prof. Dr. Alessandro Ruggiero

Department of Industrial Engineering, University of Salerno, Via Giovanni Paolo II, Fisciano, SA, Italy

Section Information

The Mechanical Engineering Section is open to receive high-quality papers reporting state-of-the-art technology in the fields of solid mechanics, machine design, advanced manufacturing processes as well as other basic phenomena in this field. The section welcomes rudimentary and challenging studies concerning the basic and advanced design of components and structures subjected to in-service loading conditions. Fluid dynamics and thermodynamics are included in this section.

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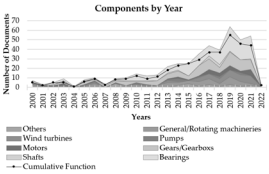
Featured Papers

DOI:10.3390/app12030972

A Review on Vibration-Based Condition Monitoring of Rotating Machinery

Authors: Monica Tiboni, Carlo Remino, Roberto Bussola and Cinzia Amici

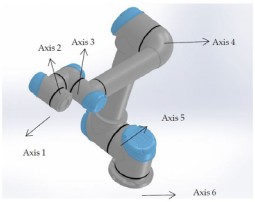


Abstract: Monitoring vibrations in rotating machinery allows effective diagnostics, as abnormal functioning states are related to specific patterns that can be extracted from vibration signals. Extensively studied issues concern the different methodologies used for carrying out the main phases (signal measurements, pre-processing and processing, feature selection, and fault diagnosis) of a malfunction automatic diagnosis. In addition, vibration-based condition monitoring has been applied to a number of different mechanical systems or components. In this review, a systematic study of the works related to the topic was carried out. A preliminary phase involved the analysis of the publication distribution, to understand what was the interest in studying the application of the method to the various rotating machineries, to identify the interest in the investigation of the main phases of the diagnostic process, and to identify the techniques mainly used for each single phase of the process. Subsequently, the different techniques of signal processing, feature selection, and diagnosis are analyzed in detail, highlighting their effectiveness as a function of the investigated aspects and of the results obtained in the various studies. The most significant research trends, as well as the main innovations related to the various phases of vibration-based condition monitoring, emerge from the review, and the conclusions provide hints for future ideas.

DOI:10.3390/app12147219

An Algorithm for Painting Large Objects Based on a Nine-Axis UR5 Robotic Manipulator

Authors: Jun Wang, Mingquan Yang, Fei Liang, Kangrui Feng, Kai Zhang and Quan Wang



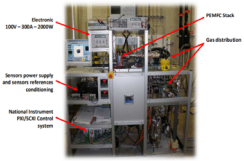
Abstract: An algorithm for automatically planning trajectories designed for painting large objects is proposed in this paper to eliminate the difficulty of painting large objects and ensure their surface quality. The algorithm was divided into three phases, comprising the target point acquisition phase, the trajectory planning phase, and the UR5 robot inverse solution acquisition phase. In the target point acquisition phase, the standard triangle language (STL) file, algorithm of principal component analyses (PCA), and k-dimensional tree (k-d tree) were employed to obtain the point cloud model of the car roof to be painted. Simultaneously, the point cloud data were compressed as per the requirements of the painting process. In the trajectory planning phase, combined with the maximum operating space of the UR5 robot, the painting trajectory of the target points was converted into multiple traveling salesman problem (TSP) models, and each TSP model was created with a genetic algorithm (GA). In the last phase, in conformity with the singularities of the UR5 robot's motion space, the painting trajectory was divided into a recommended area trajectory and a non-recommended area trajectory and created by the analytical method and sequential quadratic programming (SQP). Finally, the proposed algorithm for painting large objects was deployed in a simulation experiment. Simulation results showed that the accuracy of the algorithm could meet the requirements of painting technology, and it has promising engineering practicability.

DOI:10.3390/app12010432

A Novel Remaining Useful Life Prediction Method for Hydrogen Fuel Cells Based on the Gated Recurrent Unit Neural Network

Authors: Bing Long, Kunping Wu, Pengcheng Li and Meng Li

Abstract: The remaining useful life (RUL) prediction for hydrogen fuel cells is an important part of its prognostics and health management (PHM). Artificial neural networks (ANNs) are proven to be very effective in RUL prediction, as they do not need to understand the failure mechanisms behind hydrogen fuel cells. A novel RUL prediction method for hydrogen fuel cells based on the gated recurrent unit ANN is proposed in this paper. Firstly, the data were preprocessed to remove outliers and noises. Secondly, the performance of different neural networks is compared, including the back propagation neural network (BPNN), the long short-term memory (LSTM) network and the gated recurrent unit (GRU) network. According to our proposed method based on GRU, the root mean square error was 0.0026, the mean absolute percentage error was 0.0038 and the coefficient of determination was 0.9891 for the data from the challenge datasets provided by FCLAB Research Federation, when the prediction starting point was 650 h. Compared with the other RUL prediction methods based on the BPNN and the LSTM, our prediction method is better in both prediction accuracy and convergence rate.

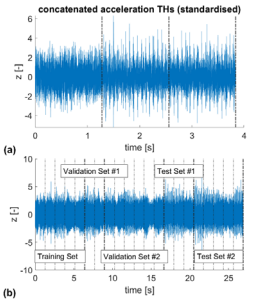


DOI:10.3390/app12031059

An Application of Instantaneous Spectral Entropy for the Condition Monitoring of Wind Turbines

Authors: Marco Civera and Cecilia Surace

Abstract: For economic and environmental reasons, the use of renewable energy sources is a key aspect of the ongoing transition to a sustainable industrialised society. Wind energy represents a major player among these natural, carbon-neutral sources. Nevertheless, wind turbines are often subject to mechanical faults, especially due to ageing. To alleviate Operation and Maintenance costs, Vibration-Based Inspection and Condition Monitoring have been proposed in recent times. This research proposes Instantaneous Spectral Entropy and Continuous Wavelet Transform for anomaly detection and fault diagnosis, departing from gearbox vibration time histories. The approach is validated on experimental data recorded from a turbine suffering bearing failure and total gearbox replacement. From a computational point of view, the proposed algorithm was found to be efficient and therefore even potentially applicable for real-time monitoring.



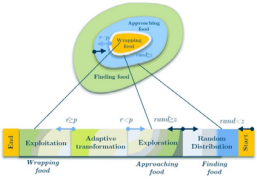
Featured Papers

DOI:10.3390/app12041876

Structural Assessment under Uncertain Parameters via the Interval Optimization Method Using the Slime Mold Algorithm

Authors: Ramin Ghiasi, Mohammad Noori, Sin-Chi Kuok, Ahmed Silik, Tianyu Wang, Francesc Pozo and Wael A. Altabey

Abstract: Damage detection of civil and mechanical structures based on measured modal parameters using model updating schemes has received increasing attention in recent years. In this study, for uncertainty-oriented damage identification, a non-probabilistic structural damage identification (NSDI) technique based on an optimization algorithm and interval mathematics is proposed. In order to take into account the uncertainty quantification, the elastic modulus is described as unknown-but-bounded interval values and the proposed new scheme determines the upper and lower bounds of the damage index. In this method, the interval bounds can provide supports for structural health diagnosis under uncertain conditions by considering the uncertainties in the variables of optimization algorithm. The model updating scheme is subsequently used to predict the interval-bound of the Elemental Stiffness Parameter (ESP). The slime mold algorithm (SMA) is used as the main algorithm for model updating. In addition, in this study, an enhanced variant of SMA (ESMA) is developed, which removes unchanged variables after a defined number of iterations. The method is implemented on three well-known numerical examples in the domain of structural health monitoring under single damage and multi-damage scenarios with different degrees of uncertainty. The results show that the proposed NSDI methodology has reduced computation time, by at least 30%, in comparison with the probabilistic methods. Furthermore, ESMA has the capability to detect damaged elements with higher certainty and lower computation cost in comparison with the original SMA.



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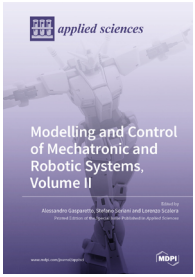

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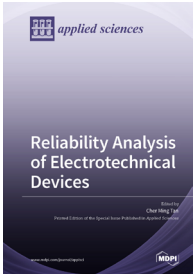

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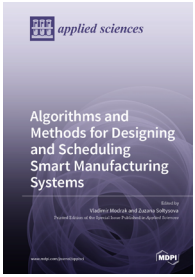

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