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FAULT DETECTION AND ISOLATION IN ROBOTIC MANIPULATOR VIA HYBRID NEURAL NETWORKS

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Abstract
Fault diagnosis systems are important for industrial robots, especially those operated in remote and hazardous environment. Faults in robotic manipulator can cause economic and serious damages. So the Robots need the ability to independently as well as effectively detect and tolerate internal failures in order to continue performing their tasks without the need for immediate human intervention. This saves time and cost involved in repairing the robot. This type of autonomous fault tolerance is also useful for industrial robots in that it decreases down-time by tolerating failures, identifies faulty components or subsystems to speed up the repair process, and prevents the robot from damaging the products being manufactured. So an attempt is made to develop a robust fault detection system to identify and isolate the faults in robot manipulator. In this paper, two artificial neural networks are employed to identify and isolate the faults. A learning architecture, approximation of dynamic behavior of robot manipulator, is used to generate the residual vector, by comparing with actual measured values. First, A multi layer perceptron feed forward network, whose structure is characterized by layered graph, trained with back propagation algorithm is applied to reproduce the dynamic behavior, then counter propagation network which learns a near optimal look up-table approximation to the mapping being approximated. The counter propagation network has the ability to compress a huge amount of data in a few weights and parameters. Simulations employing a SCORBOT ER 5u plus five links robotic manipulator are showed demonstrating that the system can detect and isolate correctly faults that occur in non-trained trajectories. The main contribution of this work is the first application of fault detection and isolation to robot manipulator with non-additive fault. 28 refs.
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Key Words: *Robot Manipulators, Fault Isolation, Fault Detection, Hybrid Neural Networks*

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FINITE ELEMENT SOLUTION OF DYNAMIC RESPONSE OF HELICAL SPRINGS

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Abstract
A numerical solution is presented to describe wave propagations in axially impacted helical springs. The governing equations for such problem are two coupled hyperbolic, partial differential equations of second order. The axial and rotational strains and velocities are considered as principal dependent variables. Since the governing equations are non-linear, the solution of the system of equations can be obtained only by some approximate numerical simulation. The finite element method, based on the Galerkin formulation, is applied to discretize the mathematical equations leading to a non-linear system of equations solved by an iterative Gauss substitution method. The computed results describe the evolution of axial and rotational strains and velocities, in different sections of the spring and show the interaction between axial and rotational waves. To validate the reliability of the model presented herein, the numerical results are compared with those of other workers obtained by the method of characteristics. 26 refs.
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Key Words: *Helical Spring, Dynamic Response, Strain, Finite Element Method, Non-linear Behaviour*

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INVESTIGATION OF THE BULLWHIP EFFECT USING SPREADSHEET SIMULATION

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Abstract
Superior supply chains are one of the best ways to compete in today's marketplaces. In Supply Chain Management, overall supply chain evaluation needs to include an important logistical effect known as the Bullwhip Effect. It shows how small changes at the demand end of a supply chain are progressively amplified up the supply chain. Production plans are based on demand forecasting and suppliers not only react on changed demand, they adapt the level of safety stock (variation of stocks and orders increases). In this paper two special situations in a four-stage supply chain are studied: i) stable demand with a single 5 % change in demand (with application of four different stock keeping policies), and ii) changing demand with alternating 5 % changes in demand (up and down, with another three stock keeping policies). The results of spreadsheet simulations are shown in tables and charts. Increasing variability of production orders and stock levels up the supply chain is evident. The Bullwhip Effect is measured by the standard deviation of orders. The comparison of the results shows that the Bullwhip Effect can be partially reduced by appropriate stock keeping policy. 20 refs.
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Key Words: *Supply Chain, Changing Demand, Bullwhip Effect, Ordering Policy*

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FINITE ELEMENT SIMULATIONS INVESTIGATING THE ROLE OF THE HELMET IN REDUCING HEAD INJURIES

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Abstract
Head injuries in motor vehicle crashes have high significance due to their fatal effects on the nervous system of passengers and pedestrians. In this study, using models of motorcyclists' helmet and the human head, two cases of head impact with a rigid surface are simulated by Finite Element Analysis; first, the impact of the head protected by the helmet and then, that of the unprotected head. In each simulation, impact parameters such as HIC, mass center velocity of the head, and pressures produced in the brain are calculated and corresponding parameters are compared with each other, which quantitatively represents the influence of the helmet on reduction of injuries to the head. Comparison of the results obtained in this study with those of previous researches indicates that if an appropriate finite element model is developed and used, FEM will lead to acceptable results in head impact simulations. 18 refs.
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Key Words: *FEM, Simulation, Head Impact, Helmet*