Original article

An integrated approach for simulation of mechatronic systems applied to a hexapod robot

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Abstract

Mechatronics is the integration of mechanism, electronics and computer control to produce a functional system. The design process involves application of many engineering areas and various approaches are possible. Computer programs are available in different engineering areas. Engineers define systems and inputs, and user-friendly programs establish mathematical models, solve them and give simulation outputs. In this study, SolidWorks is used for solid modeling and assembly, CosmosMotion is used for rigid body dynamics, CosmosWorks is used for finite element vibration and strength analyses, and Adlink module is used for actuator control. The integration of the design process is achieved with a main program developed in Visual Basic, which uses the application programming interface (API) capabilities. The procedure is applied to a hexapod robot. The robot has been produced to develop and test the procedure. CosmosMotion results are verified by the analytical results obtained from the dynamic equations of the hexapod. Besides known kinematic workspace definition of robots, kinetic and rigidity workspace concepts are introduced. Mechatronic systems can be designed and evaluated easily and effectively by using the design process developed in this work.

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1. Introduction

Mechatronics is a methodology which uses mechanics, electronics and computer control to achieve design of products where controlling of mechanical structures is necessary. Mechatronics is a branch which is evolving in the information age started after the developments in digital electronics in the late 20th century. Mechatronic design requires the application of solid modeling, assembly, rigid body motion, vibration, stress analysis, and control theories. Modern engineering theories based on advanced engineering mathematics were developed after the invention of the laws of motion. The theories require solving various types of linear and non-linear algebraic and differential set of equations with large number of unknowns. Before digital computers, some graphical and approximate methods have been used and the advanced application of the theories to engineering systems was limited. Well educated and experienced