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Weight criteria detection to find work volume of 3–PRS Parallel Manipulator using Fuzzy Logic

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Abstract

This paper focuses on finding the weight criteria to determine the work volume of a 3-PRS (Prismatic-Revolute-Spherical) parallel manipulator (PM) using Fuzzy Logic approach. The Analytic Hierarchy Process (AHP), being an uncomplicated Fuzzy logic techniquebut an authoritative decision-making toolthat has been applied to solve differentmanufacturing problems till now. In this work, the AHP has functioned to calculate the weight criteria to find work volume of the Parallel Manipulator. The results of this research may be utilized to improve the architecture of 3 degrees of freedom (DOF) parallel manipulator.

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*Keywords:*Parallel manipulator, link length, analytic hierarchy process, work volume

1. Introduction

The escalating demand of robotic structure presentation leads to the application of higher strategies. Manipulators in Robotics can be used in perilous situations for an alternate to manual labor for routine work. Comparing with conventional serial manipulator that consist of rigid body links and joints connected serially, construction of parallel manipulator provides advantages over rigidity of structure and enhanced payload shipping ability.Thus it is suitable for situations needing high precision, stiffness, velocity, and heavy load carrying is essential within a limited workspace [2]. All these advantages come up due to presence of closed loop kinematic chain mechanism

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which is connected to a fixed base platform that permits the load to transmit through several chains and cause for limiting of work space for parallel manipulator [8]. Apart from workspace parallel manipulator struggles for its complicacy of structure, highly economic and challenges for scrutiny in control. To avoid these complicacies 6 DOF might has been designed but 3DOF parallel manipulator is still struggling for its limited workspace issues and accurate positioning. Figure 1 shows the schematic representation of 3 PRS PM. The base of research lies in translation of motion between pairs of joints through links. So links play a vital role in designing a parallel manipulator. But there are many factors which affects calculating work volume of parallel manipulator.

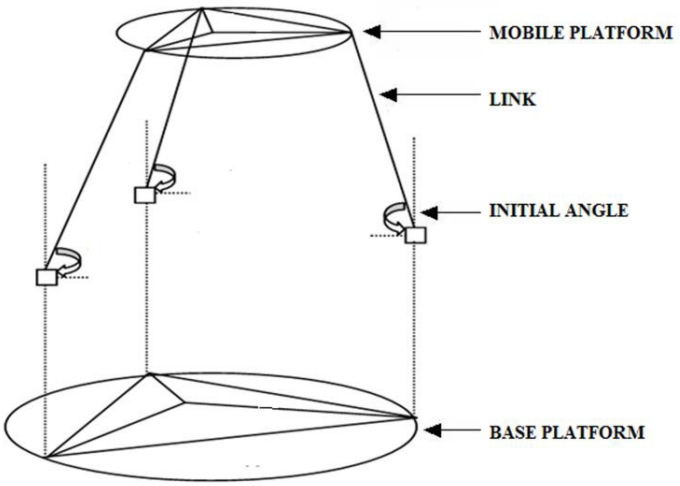

Fig. 1. 3 – PRS parallel manipulator

Analytic hierarchy process (AHP) is a simple decision making tool that can resolve many multi faced multi-criteria decision-making problems hierarchically [1]. The proposed paper addresses to find weight criteria while designing 3 DOF parallel manipulator by considering geometrical parameters.While establishing mechanical architecture of a parallel manipulator, they suffer problem during forward kinematics, for finding optimal functional workspace and intricate multi degree of freedom joints. The AHP gives the best solution towards whom to give the most importance while designing a parallel manipulator. As per great mathematician Henri, comparisons of objects regarding a property is fundamental mathematical procedure to derive measurements as because direct comparison is necessary for establishing measurements of intangible properties having no scales of the same. Using Analytical hierarchy process it has been possible to compare mutually even between the most equal parameters. The factors are arranged in a hierarchic or in a network organization and calculated as per the criterion represented within these structures. There are numeric issues which factor to be given the most importance and whom to least and also which is nearly equal. Numeric based rank criteria would have been better. AHP can deal with the theme of structuring complexity of these kind of problems, measurement and synthesizing. These characterizations make AHP effective for broader range of uses. AHP proceed with a neat solution for these kind problems. The methodology applied for acquiring the result is as follows [3, 4],

- Defining the problem clearly and get the information sought
- Structure the decision from the top along with the goal of decision.
- Architect the parameters in a set of pair wise comparison matrices
- Use the priority results from previous step to calculate the weight priority.