A Virtual Reality Environment for Spherical Mechanism Design

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Abstract

In this paper we present our ongoing effort to develop a virtual reality environment to facilitate the design of spherical mechanisms. Moreover, we review the practical motivations for the ongoing research and discuss the goals that we expect to achieve.

This virtual reality design environment will be based upon new synthesis and analysis theory as well as the existing state-of-the-art results in the fields of spatial mechanism design and virtual reality. It is our hope that this new and innovative design tool will facilitate the design and implementation of spherical mechanisms in industry.

1 Overview

The purpose of this project is to develop a virtual environment that is useful for spherical mechanism design. In spherical mechanisms "any point in a moving body is confined to move within a spherical surface, and all spherical surfaces of motion are concentric" [1]. A four bar mechanism consists of four rigid bodies(one fixed in space) that are serially connected by revolute, or pin, joints to form a closed kinematic chain. If the joint axes are parallel then the motion of the mechanism is planar. If the joint axes intersect in a point then the mechanism generates spherical motion, see Fig. 1.

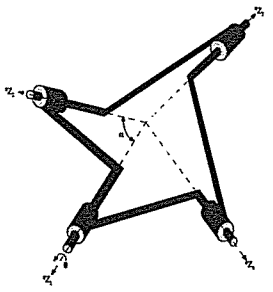

Figure 1: A Spherical $4R$ Mechanism

A spherical mechanism is the simplest mechanism that provides spatial movement. These mechanisms provide the means to move and orient a body along a complex three dimensional path in space.

The synthesis of planar mechanisms is inherently a two dimensional problem. Therefore, the design techniques are well suited to a drafting table, blackboard, etc. This is not true of spatial and

spherical mechanisms. The inherent spatial characteristics of these mechanisms makes such two dimensional graphical constructions difficult. For these mechanisms it is necessary for the designer to be able to visualize the entire problem in its three dimensions. Modern computer graphics techniques which utilize the high speed graphics capabilities of today's workstations make possible real-time visualization of spatial mechanisms. The first workstation based spherical mechanism CAD program entitled *Sphinx* has been developed by Larochelle and McCarthy, [2]. *Sphinx* uses the three dimensional graphics capabilities of Silicon Graphics workstations to provide the interactive environment needed to design spherical four-bar mechanisms. Osborn and Vance developed the first virtual reality based approach to spherical mechanism design, entitled *Sphere*-VR, [3]. Both *Sphinx* and *Sphere*-VR, have achieved some measure of success however the design process proved to be very tedious. Several designs must be investigated and prototypes of these designs must be built in order to verify the motion generated by the mechanism, [4][5]. The development of *Sphinx* has confirmed that in order to successfully design practical spherical mechanisms the inventor requires a wide variety of information, not only about the design itself but most importantly about its three dimensional working environment. Researchers from Iowa State University, University of California at Irvine, and the Florida Institute of Technology have joined together in a collaborative effort to develop such a design environment, entitled *Sphinx*-VR.

2 Conclusions

In this article we have discussed our ongoing development of *Sphinx*-VR, a virtual reality environment for the design of spherical four bar mechanisms.

It is our hope that this new design and analysis tool will facilitate the design and utilization of spherical mechanisms to solve spatial motion problems.

3 Acknowledgements

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References

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