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TitleLine: Visualization of CAD Objects Using a Stereoscopic Display

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Abstract:

Subjects memorized the shape of a static 3-D object displayed on a stereoscopic CRT. In each of a series of trials that followed, single static objects were presented. The angular orientation of each trial object was one of six 36-degree increments relative to the angle of the memorized stimulus. The subject's task was to determine, as quickly and accurately as possible, whether the trial object was the same shape as the memorized object or its mirrored image. One of the two cases was always true. Disparity and interposition were manipulated in a within-subject manner during the initial memorization period and the trials that followed. Subject response time and error rate were evaluated. The experimental objective was to determine the extent to which stereopsis and hidden surface affect subjects' ability to 1) transfer to and retrieve from long-term memory spatial information about a 3-D object, and 2) visualize spatial characteristics in a quick and direct manner. Improved performance due to hidden surface is the most convincing experimental finding. The study also found a significant but limited stereopsis effect.

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TitleLine: An Unified Approach to the Stable Contact Configurations of Workpieces

Abstract:

In this report, we examine the linear dependency of the Grassmann line geometry using the theory of reciprocal screw. Several symptoms of the degeneracy of a set of lines are then applied to analyze the mechanics of a workpiece subjected to multiple contacts and to the synthesis of singularity of serial mechanisms. Numerous properties on the reciprocal screw for degenerated systems are developed. Using these properties, we are able to discover several sufficient conditions for the form-closure of the problems involving multiple contacts of rigid bodies such as fixture design and multi-fingered grasping. This issue is important to assembly planning. Existing criteria for placing the supports around a workpiece are justified under our approaches and several new rules are also developed based on these sufficient conditions. Finally, we take the same approach to detect the singularities of 6R serial mechanisms.

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TitleLine: Interactive Visualization for Assembly

Abstract:

Assembly planning is an important component for automation in manufacturing. It can help reduce the production cost by avoiding unstable subassemblies and eliminating unnecessary tool changes within the assembly cell. The assembly plan generation process begins with the exploration of the precedence relations due to geometrical and mechanical constraints. After the precedence relations are derived, all feasible assembly sequences are generated. A diamond-shape graph is commonly used to visualize all possible assembly sequences. A dual representation of all assembly sequences is also provided to facilitate the assembly sequence comparison task. Each possible sequence is transformed into a nodal representation and assumes a spatial location in a three-dimensional space. The proximity among all assembly sequence nodes in the dual space is designed to reflect the similarity among the sequences. The user can therefore navigate in the space of all feasible

assembly sequences and compare similar assembly sequences that are clustered closely in the dual space. All three visualizations, namely the precedence relation, the diamond graph, and the dual graph, are coupled together so that interactions on one visualization are reflected on the other two.