In this paper, we enhance our knowledge-based and constraint-based approach of robot programming with the concept of Semantic Mates. They describe intended mechanical connections between parts of an assembly. This allows deriving appropriate assembly poses from the type of connection and the geometric properties of the involved parts. The paper presents an ontology-based representation of Semantic Mates that is used to augment object models with additional information regarding their potential use in an assembly. Such semantically annotated object models can be used in our instruction framework to program a robot to perform assembly tasks through simple drag-and-drop operations in a graphical user interface. We conducted a user study with 21 participants in order to evaluate the efficiency and usability of the Semantic Mates concept based on a use-case from the domain of mechanical assembly. Across different experience levels in robotics, the participants achieved a significantly faster workflow and improved perceived usability compared to the manual specification of constraint-based assembly operations.
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