



Smooth Motion Control Using Navigation Generation and Interpolation in Robotic Kinematics

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DESCRIPTION

Robotics kinematics is a fundamental aspect of mechanical engineering that deals with the study of motion, position, and velocity of robotic systems. It lays the foundation for understanding the movement of robotic manipulators, aiding in their design, control, and optimization. Kinematics allows engineers to analyze and predict how robots move and interact with their environment, a critical requirement for various applications, from industrial automation to healthcare robotics. Robotics kinematics involves the study of the movement of robotic systems without considering the forces that cause the motion. It primarily deals with position, orientation, and velocity, enabling the computation of the robot's end-effector's location.

Degrees of Freedom

Degree of freedom is the number of independent movements a robotic system can perform. It is a vital parameter that influences a robot's flexibility and versatility in executing tasks. Kinematics employs coordinate systems to define the position and orientation of different robot components.

Frame of reference

Frame of reference is used to establish a standardized way of describing the robot's motion and location.

Forward kinematics

Forward kinematics calculates the position and orientation of the robot's end-effector based on the known joint angles and link parameters. It helps determine where the end-effector is in space concerning a fixed coordinating system.

Inverse kinematics, on the other hand, involves calculating the joint angles required to position the end-effector at a specific

location and orientation. It is essential for robot control and trajectory planning. Differential kinematics computes the end-effector's velocity and angular velocity based on the joint velocities. It provides insights into how fast the robot can move and the relationships between joint velocities and end-effector velocities.

Kinematics is extensively used in industrial robots to plan and control their movements on the factory floor. Robots employed in manufacturing processes, such as welding, painting, and assembly, rely on kinematic principles to carry out precise tasks efficiently. Robotics kinematics is critical in the field of medical robotics, aiding in the design and operation of surgical robots. Surgical robots need precise movements and control, and kinematics is instrumental in ensuring accuracy and safety during medical procedures. In the aerospace industry, kinematics is employed for the design and control of robotic arms used in satellite maintenance, space exploration, and military applications. Kinematic modeling enables the efficient deployment of robots in these challenging environments. Service robots, such as those used in search and rescue operations or household chores, rely on kinematics to navigate and perform tasks efficiently. Understanding motion dynamics is essential for these robots to operate effectively in diverse environments.

Kinematics aids engineers in designing robotic systems with the desired movement capabilities and efficiency. Optimizing kinematic designs leads to improved performance and reduced energy consumption. Understanding kinematics is vital for the effective control and programming of robotic systems. It allows engineers to develop control algorithms that guide robots to execute tasks accurately and precisely. Kinematics helps in evaluating the safety and reliability of robotic systems by predicting and analyzing their movements. Engineers can identify potential collisions or hazardous motions, ensuring the safety of

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the robot and its surroundings. Advances in kinematics drive innovation in robotics, finding new ways for the development of new types of robots and improved control strategies. Kinematics research is at the focus of shaping the future of robotics and automation. Robotics kinematics serves as the fundamental of understanding robotic motion, providing valuable insights into how robots move and interact with their environment. Its

significance in mechanical engineering is immense, enabling the design, control, and optimization of robotic systems for a wide array of applications. From industrial automation to healthcare and beyond, robotics kinematics plays a pivotal role in shaping the present and future of robotics technology, offering solutions that enhance efficiency, precision, and safety across various industries.