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CONTROL SYSTEMS

NON-TRADITIONAL ACTUATION METHODS

CONCEPT Non-traditional actuation methods refer to a set of advanced manufacturing techniques that use unconventional methods to control the motion of machines and tools in the manufacturing process. These methods are often used in situations where traditional mechanical or electrical actuation methods are insufficient or impractical. Examples of non-traditional actuation methods include piezoelectric actuators, magnetostrictive actuators, shape memory alloy actuators and electroactive polymer actuators. These technologies are increasingly used in advanced manufacturing processes, such as precision machining, microfabrication and additive manufacturing, to improve the accuracy, speed and efficiency of manufacturing operations. They offer advantages such as high precision, low energy consumption and compact size, and are expected to significantly impact the future of advanced manufacturing.

BACKGROUND

Non-traditional actuation methods in advanced manufacturing have a relatively recent history, dating back to the mid-20th century. The development of materials with unique properties, such as shape memory alloys and electroactive polymers, paved the way for new actuation technologies. In the 1960s, piezoelectric actuators were first used in precision machining applications. In the 1980s, magnetostrictive actuators were developed for use in vibration control and noise reduction. Electroactive polymers were first explored as actuation materials in the 1990s and have since found applications in soft robotics and wearable devices. Non-traditional actuation methods continue to be an area of active research and development, with new materials, design strategies and fabrication techniques being explored to enable even more advanced and precise manufacturing processes.

EXAMPLES

ACTUATORS: These devices convert electrical, magnetic or thermal energy into mechanical motion. Non-traditional actuation methods use various types of actuators, such as piezoelectric actuators, magnetostrictive actuators, shape memory alloy actuators and electroactive polymer actuators.

SENSORS: These devices detect changes in the environment and provide feedback to the actuator to adjust its output. In non-traditional actuation methods, sensors are often integrated with the actuator to provide closed-loop control of the manufacturing process.

CONTROL SYSTEMS: These software programs manage the actuation and feedback systems in the manufacturing process. Control systems can be programmed to adjust the actuator's output based on the feedback from the sensors, allowing for precise and accurate control of the manufacturing process.

POWER SUPPLY: Non-traditional actuation methods require a power supply to operate the actuator. Depending on the type of actuator, the power supply can be electrical, magnetic or thermal.

MATERIAL SELECTION: The materials used in non-traditional actuation methods are critical to their performance. For example, shape memory alloys require careful selection to achieve the desired deformation and recovery behavior.

DESIGN AND FABRICATION TECHNIQUES: Non-traditional actuation methods often require specialized design and fabrication techniques to create the required components and integrate them into the manufacturing process. For example, microfabrication techniques are used to create piezoelectric actuators and sensors for use in micro-electromechanical systems (MEMS).

Make sure it measures up

REAL WORLD CONNECTIONS

One example of non-traditional actuation methods is the use of electroactive polymer (EAP) actuators in the development of soft robotics. EAP actuators can mimic the movement of natural muscles. These devices have potential applications in fields such as medicine, where they could be used for surgical and rehabilitation purposes. The EAP actuators used in these devices are lightweight, flexible and can be controlled with low voltages.

The soft robotic glove used for stroke rehabilitation patients is a great example. It uses EAP actuators to provide assistance and resistance during hand movement exercises, which can help improve hand function and mobility in stroke patients. The glove is designed to adjust to fit different hand sizes. The EAP actuators used in the glove are controlled by a computerized system that monitors the patient's movement and adjusts the level of assistance and resistance as needed.