Docket #: S24-171

Reconfigurable Joint Limits and Workspaces

Researchers at Stanford University have developed an innovative hardware-based reconfigurable joint limit mechanism and module that precisely constrains a robot's workspace through pre-performance adjustments. By setting specific joint limits before operation, the module customizes the robot's range of motion for individual tasks and user safety, significantly reducing the risk of malfunctions or operator errors compared to traditional software methods.

Robots are integral across various industries, enhancing efficiency in tasks ranging from assembly to medical procedures. Therefore, safety is paramount, especially in collaborative human-robot environments. However, in most commercial applications, robots are not tailored for specific tasks—their workspaces are generally larger than necessary for the intended task, increasing the risk that an unintended movement could harm nearby individuals or even those in direct contact with the robot.

To ensure safety, traditional methods rely on:

- Software-Controlled Virtual Boundaries: These mitigate risks in human-robot interactions but are vulnerable to control errors and sudden external forces.
- Compliance Control: This approach helps moderate contact but depends heavily on software accuracy.
- Fixed Mechanical Hard Stops: These provide a single, unchangeable limit and do not allow for workspace customization.

To address these limitations, researchers at Stanford have developed a joint limit mechanism and module that enable users to adjust the range of motion for each joint and thereby reconfigure the robot's workspace. The hard stop limit component is electronically reconfigured—to a specific angle for revolute joints or a defined distance for linear joints—and then mechanically fixed in place. This invention enables adaptive modifications based on task requirements while enhancing safety

with reduced reliance on software controls.

Key Advantages:

- Enhanced Safety: Adjusting joint limits according to task-specific requirements minimizes unintended movements and reduces potential harm, particularly in environments where robots work around or directly on humans.
- Customizability: In surgical applications, the module can tailor joint limits to match a patient's anatomy and procedural needs. In assistive robotics, it ensures controlled and safe interactions, while in industrial settings, it confines the robot's workspace to prevent collisions and injuries.
- Reduced Software Reliance: By providing a hardware-based solution, this mechanism minimizes dependency on error-free software, offering a more robust and adaptable approach for maintaining safety in diverse operational environments..

Stage of Development
Prototype

Applications

- Robotics

Advantages

- Versatility
- Adaptability
- Enhanced safety

Innovators

- Boyeon Kim
- Oussama Khatib

Licensing Contact

Luis Mejia

Senior Licensing Manager, Physical Sciences

Email