# AWSOM: Designing an Active Wrist Mechanism Utilizing Spherical-Gears and a One-Drive Mechanism

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The wrist is a compact multi-dimensional mechanical actuation structure in humanoid robot design. The mechanical structure of the human-shaped wrist should meet the requirements of the multi-directional mobility of the hand, the accuracy of movement, and the single drive of the wrist. These requirements have made it a great challenge to construct an active wrist mechanism with the shape of a human forearm. The challenge focused on three issues of wrist mechanics and drive design: How to provide multi-Degree-Of-Freedom (DOF) rotational motion for the wrist mechanism? How to provide a 3-DOF motion drive at the wrist joint? How to create a wrist mechanism with human forearm shape and proportions? Most existing actively actuated wrist solutions typically focus on multi-DOF functionality. They are mainly used in industrial application scenarios and are unsuitable for humanoid robots due to their complex multi-joint and parallel mechanical structures. This project proposes a spherical gear-based joint mechanism to construct an actively actuated wrist mechanism. The proposed solution designs a compact linear actuation module with only one gear-based actuator to provide a linear structure that mimics the human forearm shape and wrist mechanism. The presented 2-cross spherical gears and re-meshing design allow the spherical gears to move with 3 degrees of freedom to mimic the mobility of the human wrist. In addition, the gear-based approach can provide more accurate wrist positioning than existing solutions and simplify wrist design without orientation sensors.

**Awards Won:**