Hands-on Robotics (HRB) Widgets

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Motivation

Hands-On Robotics (HRB) is a project-based course focused on rapid iteration, where robotic systems are frequently reused, modified, and reconfigured throughout the design process. This makes connection methods critical, as they directly affect both development speed and structural reliability.

Our goal is to develop modular, easy-to-use connectors that enable fast assembly, stable and repeatable connections, and flexible reconfiguration. These connectors are intended to support efficient prototyping and improve overall system robustness for use in both the class and BIRDS-Lab.

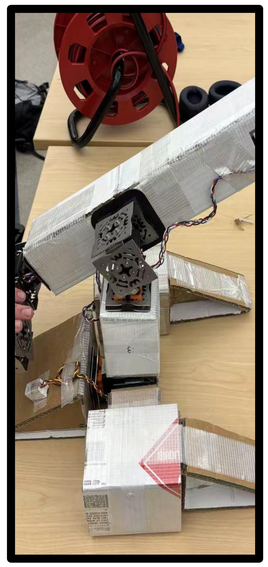


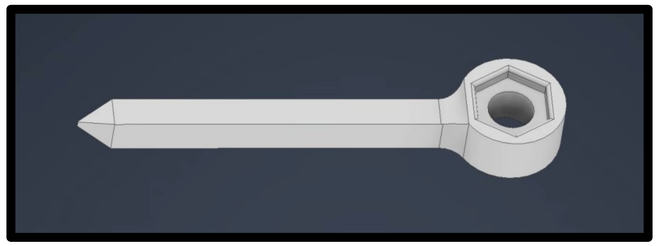
Figure 1. Robot arm base.



Figure 2. Joint connection between two cardboard arms

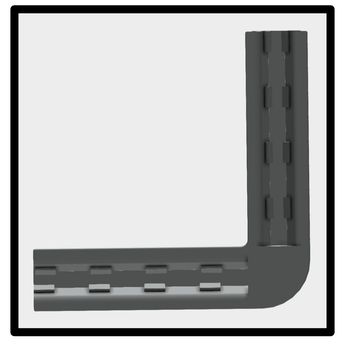
Angle-Adjustable Insert

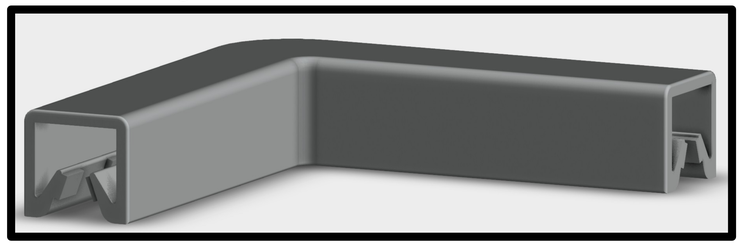
- Insert placed within corrugated cardboard core using side arms
- A central screw connects multiple arms, allowing each one to rotate to different angles
- Reduces shear force by redistributing loads across corrugated layers inside the cardboard



Angle Locking Joint

- Connects two cardboard panels at fixed angles (e.g., 90°, 45°, 30°)
- Enables quick assembly of angled structures without extra fixtures
- Maintains consistent geometry during prototyping
- Integrated “teeth” increase friction and mechanical interlocking

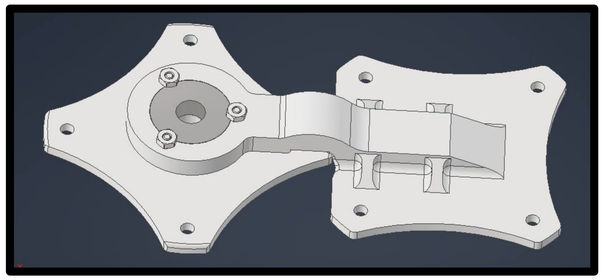




Rotational Connector Module

- 1-DOF rotational joint with axis perpendicular to base
- Enables controlled rotation while maintaining structural support
- Bearing integrated to ensure smooth and stable motion
- Secured by central screw with auxiliary screws locking bearing in place

Advantages:
- Replaces tape joints
- Faster assembly and disassembly
- Better alignment and reusability



Self-Locking Screw Through Tube

- Tube consisting of two different symmetrically compatible parts
- Strong enough and sharp enough to cut through cardboard and secure two pieces together
- Useful for protecting interior structure of cardboard.
- Protects cardboard from abrasion by screw threads

