

## Extendable Flex Shaft

**This technology offers a flexible, extendable torque transmission device that is easily fabricated and reduces the mechanical complexity of the current approaches. The system gains its mechanical properties by wrapping a repeated geometric tiling to create a hollow cylinder.**

### What is the Problem?

Driveshafts for transmitting mechanical torque and rotation commonly exist as components in a wide variety of devices including vehicles and machines. At present, changes in alignment and distance between the driving and driven components rely on incorporating additional mechanical components such as universal joints, jaw couplings, flex shafts or rag joints. In order to transmit several individual torques, multiple such mechanisms must be rigged in parallel. In applications such as robotics, catheters, and inspection equipment, an easily fabricated method that can send multiple torques down a single curve while remaining coaxial is desired.

### What is the Solution?

The solution is a hollow, extendable, and flexible driveshaft. This structure gains its mechanical properties by wrapping a repeated geometric tiling to create a hollow cylinder. A series of compliant linkages make a single unit cell with specifically constrained multi-degree of freedom (DOF) movement with the Watt's mechanism making up the base unit cell. Tiling this unit cell around a cylinder creates a structure with low resistance to extension and a high resistance to torsion. Adjusting the dimensions of linkages and cylinder varies the effective expansion ratio and effective compliance tensor. This device consists of tiling straight-line mechanisms around a shaft to produce a near zero Poisson ratio material. This structure then can expand along the axis of the cylinder and resist torsion. The resulting structure acts as a flexible, extendable torque transmission device. Combinations of multiple hollow flex-shafts may be nested concentrically with the outer surface of one hollow shaft contained within the inner surface of another. Multiple individual torques may be transmitted between concentrically nested driving and driven components. These devices can be held at a constant offset using bearings or bearing surfaces to ensure they remain concentric through deformation and rotation.

### What Differentiates it from Solutions Available Today?

There is currently no easily fabricated method that can send multiple torques down a single curve while remaining coaxial, resulting in mechanically complicated devices with a higher cost. This solution is a flexible, extendable torque transmission device that is easily fabricated and reduces the mechanical complexity of the current approaches.

### Technology ID

BDP 8714

### Category

Materials/Other  
Selection of Available  
Technologies

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### Learn more



**Patent Information:**

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