

# Novel Legged Omni Crawler to wheel Transforming Module

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## 1. Introduction:

- **Robots for structured and slightly uneven surface**

**Wheeled and tracked robots:** More feasible than legged robots due to complex Control system.

- **Robots for All-terrain**

**Hybrid locomotion modes:** Wheel, Leg or Track- allows a robotic platform to exploit the most appropriate locomotion mode, in terms of ease of control and efficiency.

**Motivation:** Hybrid Robots in literature incorporate rigid non-compliant legs (without knee joint), which does not facilitate efficient navigation on the highly unstructured environment.



Fig. 1: Quadruped incorporating CObRaSO module in [1] Crawler configuration, [2] Legged configuration, [3] Wheeled configuration;

## 2. Transformable Omni-Crawler

- Proposed a Novel Design of a transformable hybrid legged-crawler Module, as shown in Fig. 2.
- Augments locomotion capabilities of a hybrid robot by transforming from crawler-legged mode to large diameter spiked-wheel.
- **Transformed large sized spiked-wheel mode:** enables it to navigate through cluttered environment with small and medium sized obstacles (height < 9cm).

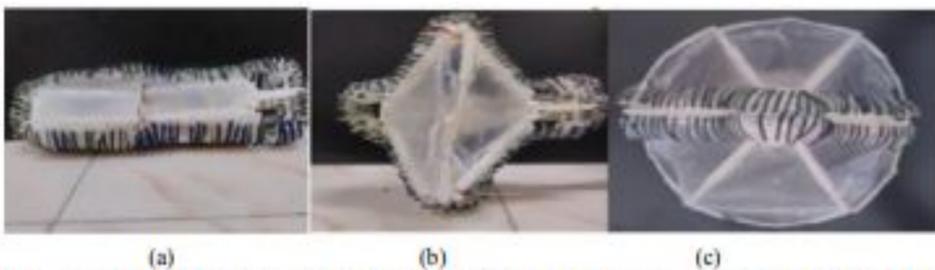


Fig. 2: Transformable compliant Omni crawler robot, (a) Elongated Crawler mode, (b) Transformed wheeled mode side view, (c) Transformed wheeled mode

## 3. Robot Design

- This transforming mechanism, consists of a cascaded structure of 3 DOF parallel manipulator platform.
- Platform realized with 6 pairs of complementary left-right handed screws.

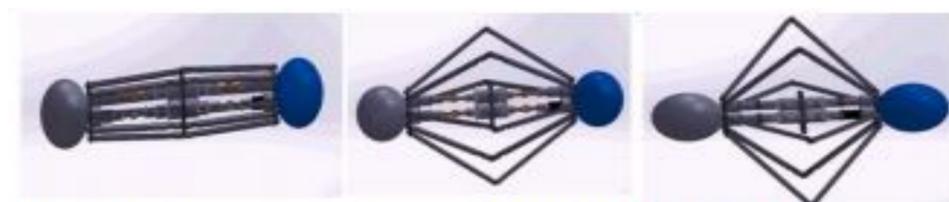
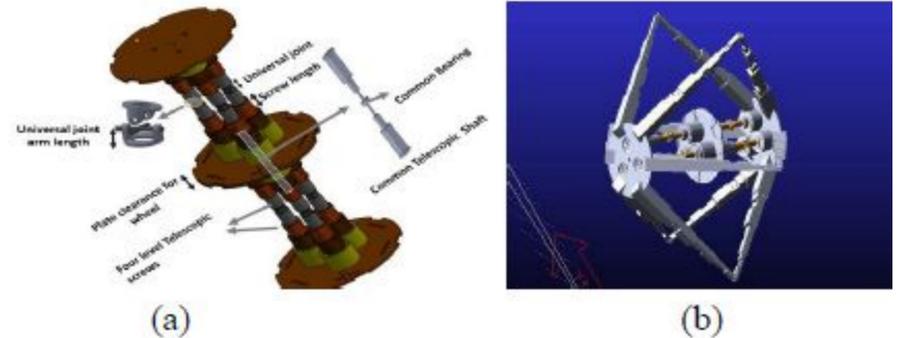


Fig 3.: The transformation from crawler to spiked-wheeled mode.



Fig 4: (a) Prototype of the module in the bend configuration. (b) The telescopic screw based 3-DOF manipulator achieving bend configuration.



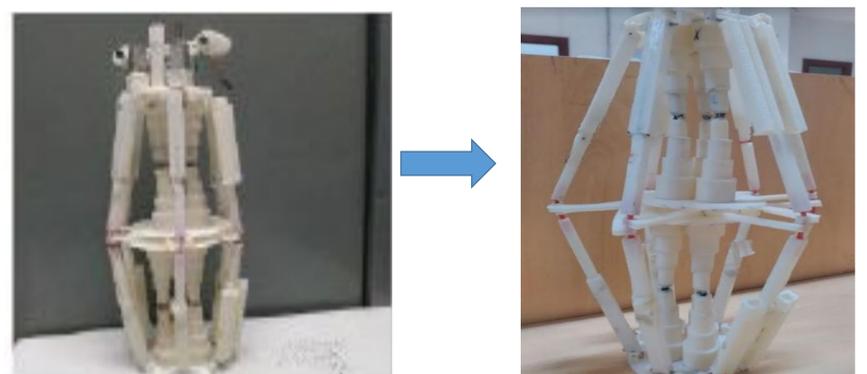
## 4. Chassis Design and Transformation

- **Compliant Chassis using silicon layer:** Facilitates crawling motion even in bent configuration.
- **Transformation from Crawler to spiked-wheeled mode:** Increase in radial length of the module is uniform along all directions.
- **Spiked-wheel structure:** Perfect circular surface..



## 5. Simulation and Experiments

- **Synchronous control of all actuators:** Transformation from crawler to wheel by varying the the length of telescopic cascaded 3-DOF platform.
- **Estimated motor torque during transformation:** Crawler mode to wheeled mode is achieved by simulating the model in ADAMS MSC.



## 6. Conclusion and Future Work:

- Module is capable of changing its length and diameter over a wide range. The compliant behavior of the Omni-Crawler module is now supplemented with high mobility of wheels.

## 7. References:

- [1] Singh, Akash, et al. "CObRaSO: Compliant Omni-Direction Bendable Hybrid Rigid and Soft Omni Crawler Module." arXiv preprint arXiv:1709.10452 (2017).
- [2] Ishii, Chiharu, et al. "Robotic forceps manipulator with a novel bending mechanism." IEEE/ASME Transactions on Mechatronics 15.5 (2010).