

A Soft Drone For Whole Body Perching

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Research Statement

Due to limitations of the fully fabric based pneumatic actuator on arm rigidity, decreased performance upon assembly and fabrication errors, we present the soft bending actuator design supported with bistable material to ensure reliability and better stability

Fabrication of pneumatic actuator

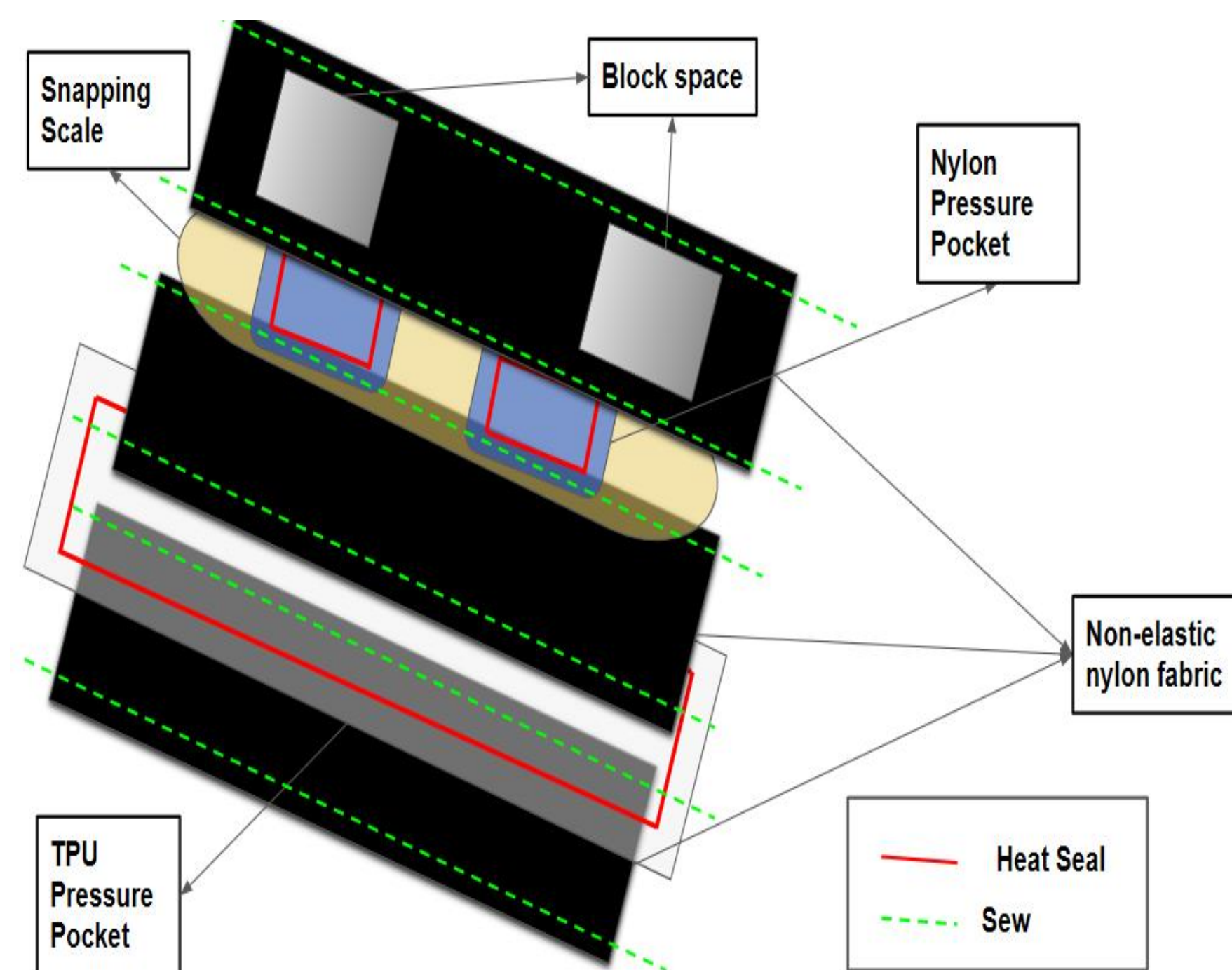


Fig.(3): Schematic of the pneumatic arm fabrication

- 3D print PLA holder blocks, chassis and motor mount using Prusa Slicer
- Laser Cut the coiling actuator fabric into small squares and then heat seal at 400 degree F at about 30 sec
- Prepare TPU pressure pockets by heat sealing two TPU rectangular layers at about 400 degree F for 15 sec
- Sew the three non-elastic layers shown in black

Conceptual Design

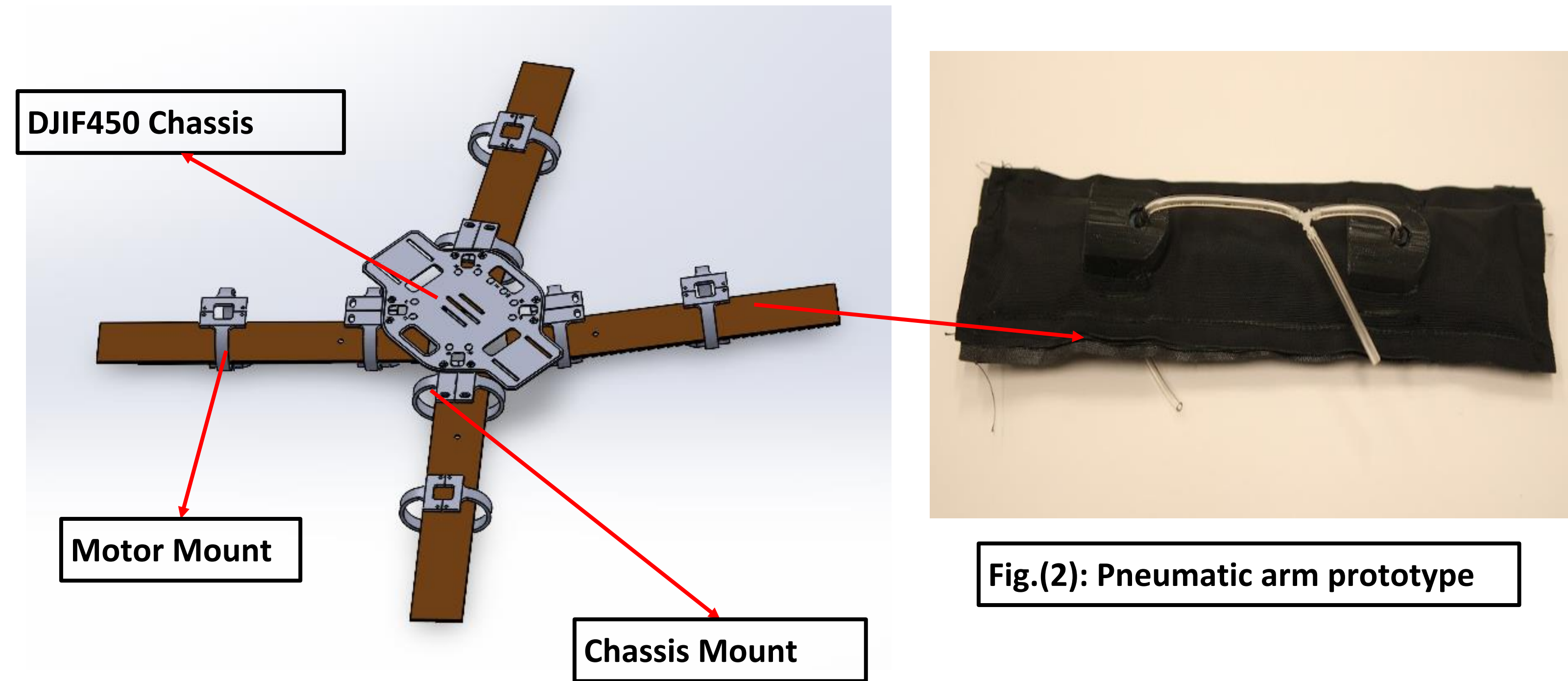


Fig.(1): Drone Assembly design

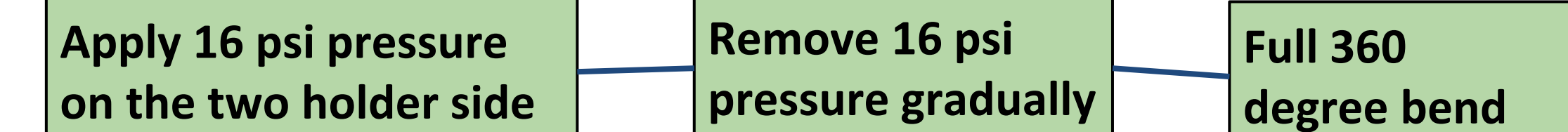
Fig.(2): Pneumatic arm prototype

Performance Analysis

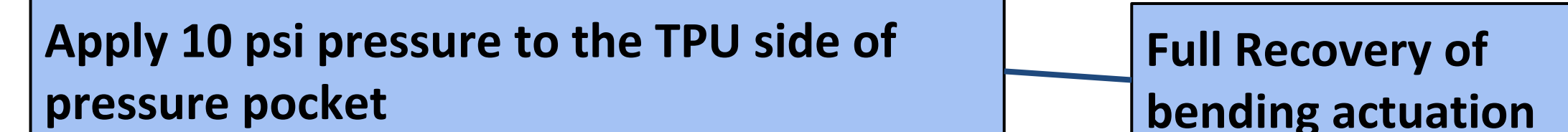
- Bistable material used helps improve rigidity of the pneumatic actuator
- Can withstand real environment conditions due to better rigidity and stability
- Lower activation time compared to the mechanical actuator design, which had frictional losses.
- Both before and after the arm integration to the drone chassis, complete 360 degree bends with less than 20 psi pressure is possible
- Decreased risk of fabrication error as all the manufacturing steps(except sewing) are automated
- For coiling, non-elastic material is used which prevents the risk of rupture in the pressure pocket upon overinflation
- Helps save on energy during flight as it can easily

Activation Mechanism

Coiling Actuation



Recoiling Actuation



Testing and Evaluation

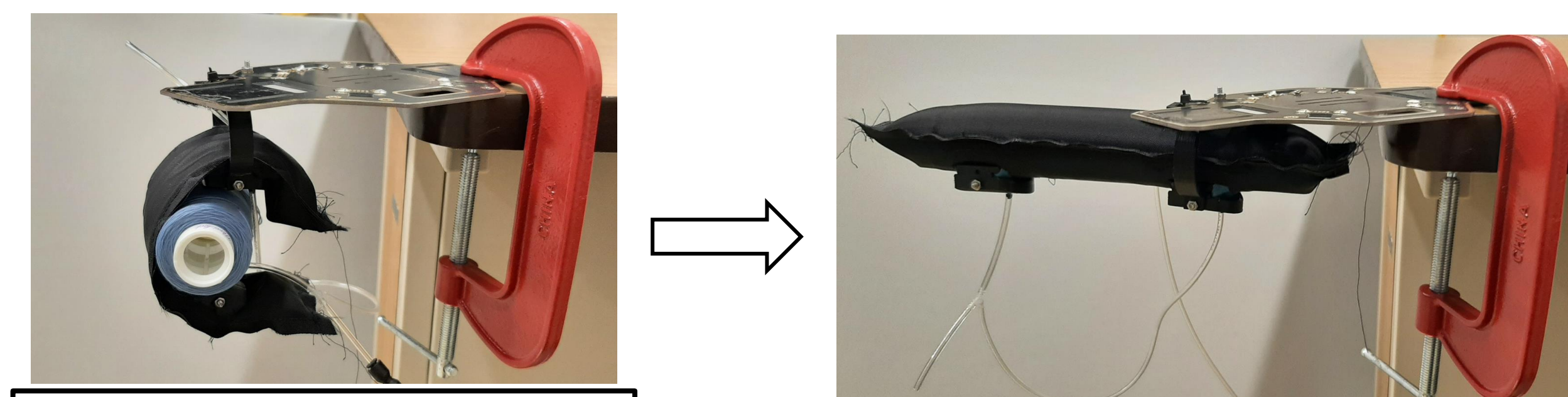


Fig.(4): Coiling stage(P=20 psi)

Fig.(5): Recoiling stage(P=12 psi)

Pressure Test results:

- It was observed that when the pneumatic arm was assembled with the drone chassis, the pressure required for actuation increased by 3-5 psi.
- One arm itself is compatible enough to hold the weight of the object as seen in fig.(4) with complete 360 degree bending capability

Acknowledgements

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