

Project 3.1: Multi-material Gripper utilizing Additive Manufacturing

Overall problem

- Complicated mechanism and design



- Lacks flexibility in actuations

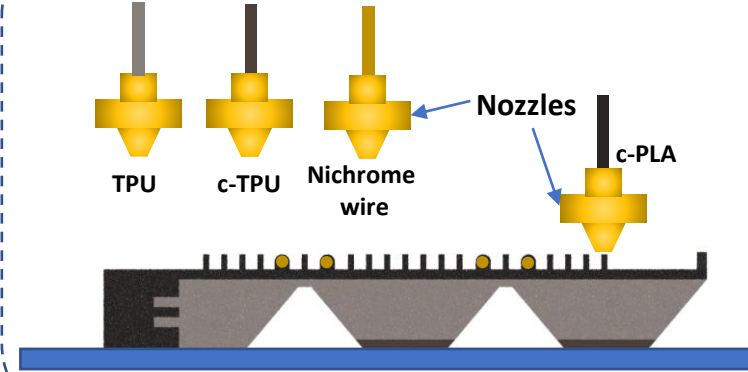


- Soft grippers produces low grip force

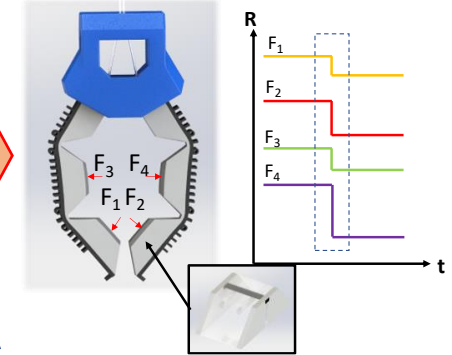


Proposed approach

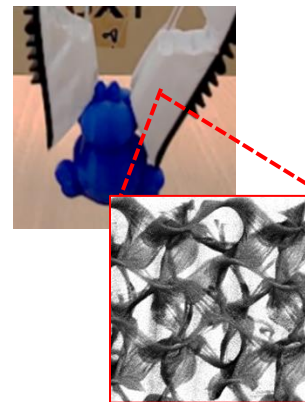
Functional Materials + 3D multimaterial printing



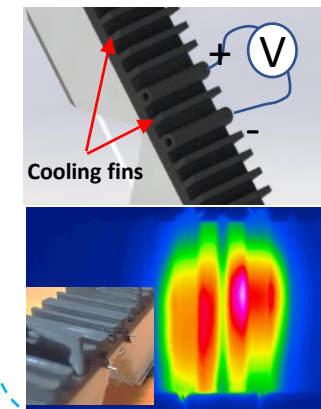
Smart sensing



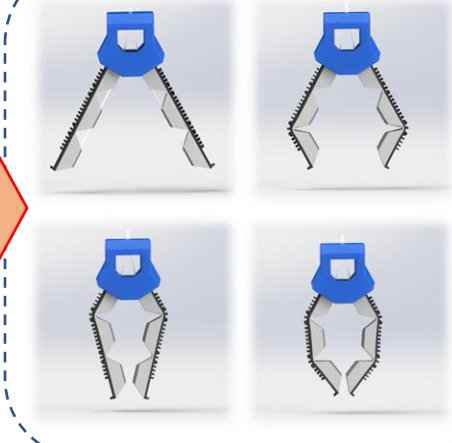
Soft touch



Stiffness-tuneable joints



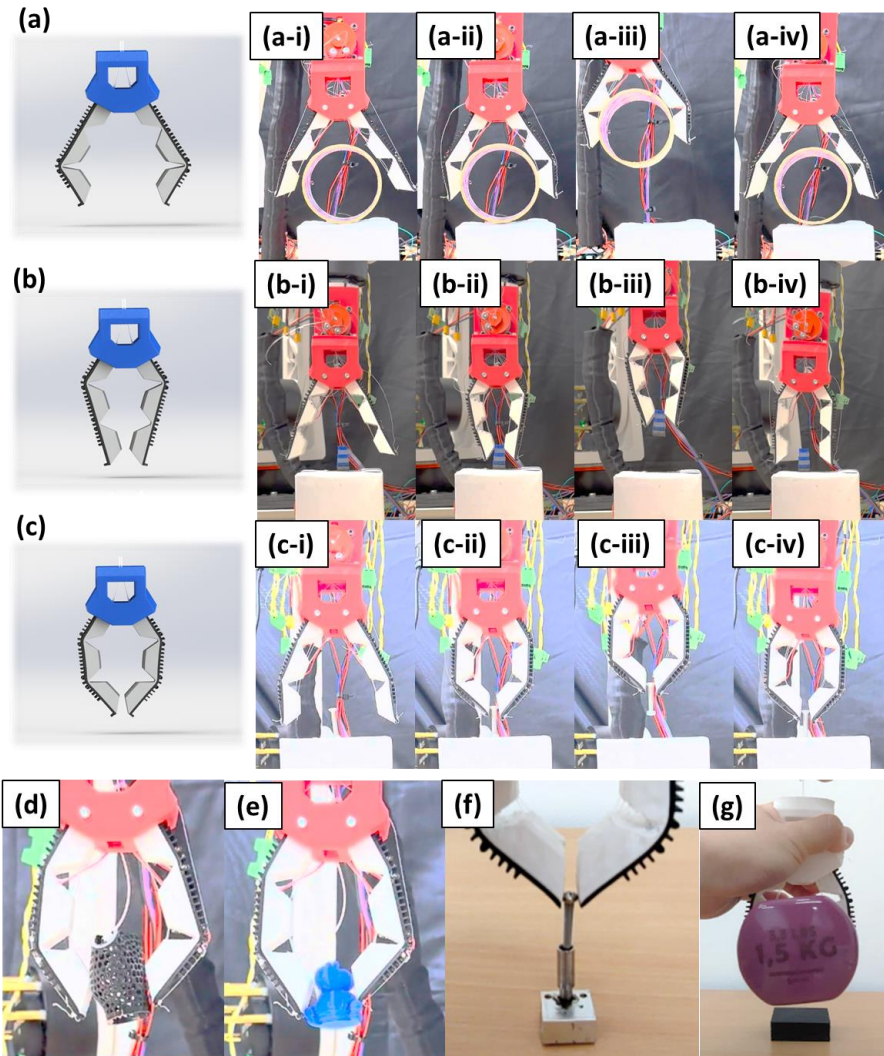
Flexible actuations



Unique feature: universal smart gripper with variable joint stiffness

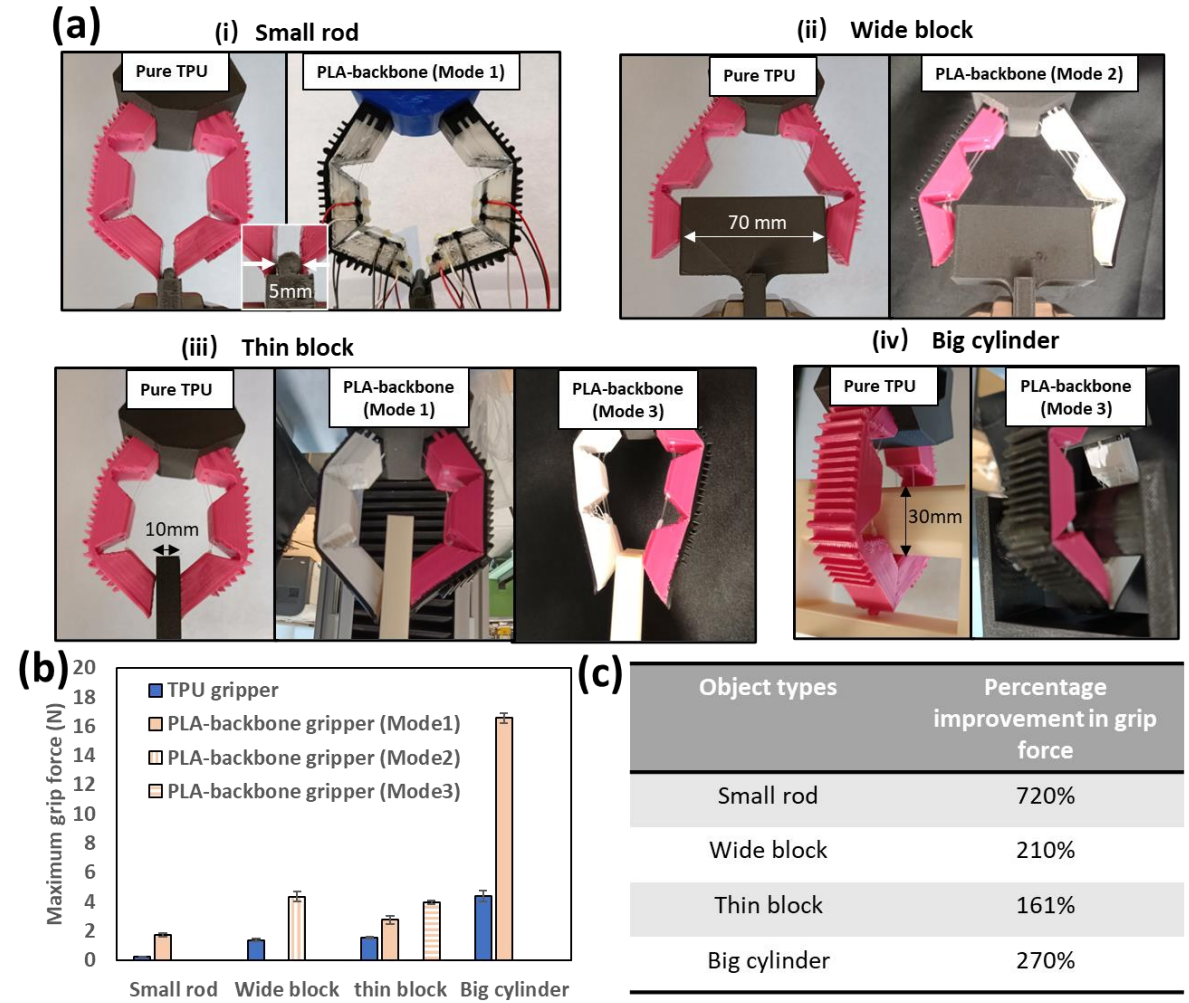
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Gripper versatility study



Suitable for objects of various sizes and weights

Grip force study



Improved grip force compared to typical soft grippers

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Notable outcomes

4 Published papers:

- Goh, G. L., Lee, S., Han, B. S., & Yeong, W. Y. (2024). **Interlaminar Adhesion Study of Fused Filament Fabrication (FFF)-Printed Soft and Rigid Bilayer Structure with Composites**. In Materials Science Forum (Vol. 1112, pp. 73–80). Trans Tech Publications, Ltd. <https://doi.org/10.4028/p-h3kmtx>
- Guo Liang Goh, Samuel Lee, Shi Hui Cheng, Daniel Jee Seng Goh, Pothunuri Laya, Van Pho Nguyen, Boon Siew Han, Wai Yee Yeong. **Enhancing interlaminar adhesion in multi-material 3D printing: A study of conductive PLA and TPU interfaces through fused filament fabrication**. MSAM 2024, 3(1), 2672. <https://doi.org/10.36922/msam.2672>
- G. L. Goh, G. D. Goh, V. P. Nguyen, W. Toh, S. Lee, X. Li, B. D. Sunil, J. Y. Lim, Z. Li, A. K. Sinha, W. Y. Yeong, D. Campolo, W. T. Chow, T. Y. Ng, B. S. Han, **A 3D Printing-Enabled Artificially Innervated Smart Soft Gripper with Variable Joint Stiffness**. Adv. Mater. Technol. 2023, 8, 2301426. <https://doi.org/10.1002/admt.202301426>
- G. D. Goh, G. L. Goh, Z. Lyu, M. Z. Ariffin, W. Y. Yeong, G. Z. Lum, D. Campolo, B. S. Han, H. Y. A. Wong, **3D Printing of Robotic Soft Grippers: Toward Smart Actuation and Sensing**. Adv. Mater. Technol. 2022, 7, 2101672. <https://doi.org/10.1002/admt.202101672>

3 Conference presentations and papers:

- Goh, G. L., Lee, S., Han, B. S., & Yeong, W. Y. (2024). **Interlaminar Adhesion Study of Fused Filament Fabrication (FFF)-Printed Soft and Rigid Bilayer Structure with Composites**. In Materials Science Forum (Vol. 1112, pp. 73–80). Trans Tech Publications, Ltd. <https://doi.org/10.4028/p-h3kmtx>
- Yeong, W. Y., Goh, G. L., Goh, G. D., Lee, S., Altherr, J., Tan, J., & Campolo, D. (2022). **3D printing of soft grippers with multimaterial design: Towards shape conformance and tunable rigidity**. Materials Today: Proceedings, 70, 525-530.
- Goh, G. L., Yeong, W. Y., Altherr, J., Tan, J., & Campolo, D. (2022). **3D printing of soft sensors for soft gripper applications**. Materials Today: Proceedings, 70, 224-229.

2 Technical disclosures/Patents:

- **3D Printed Multimaterial Robotic Gripper With Autonomous Spring-Back Mechanism And Integrated Joint Thermocouples** (Non-drafted Singapore provisional patent · Filed Jan 11, 2024)
- **3D printed multimaterial gripper with embedded sensors and variable-stiffness joints** (Singapore provisional patent application number 10202302134R · Filed Jul 26, 2023)

Future work

