

# From Paper to Space: Testing Origami-Inspired Structures in a CubeSat Mission

Ines Uriol Balbin

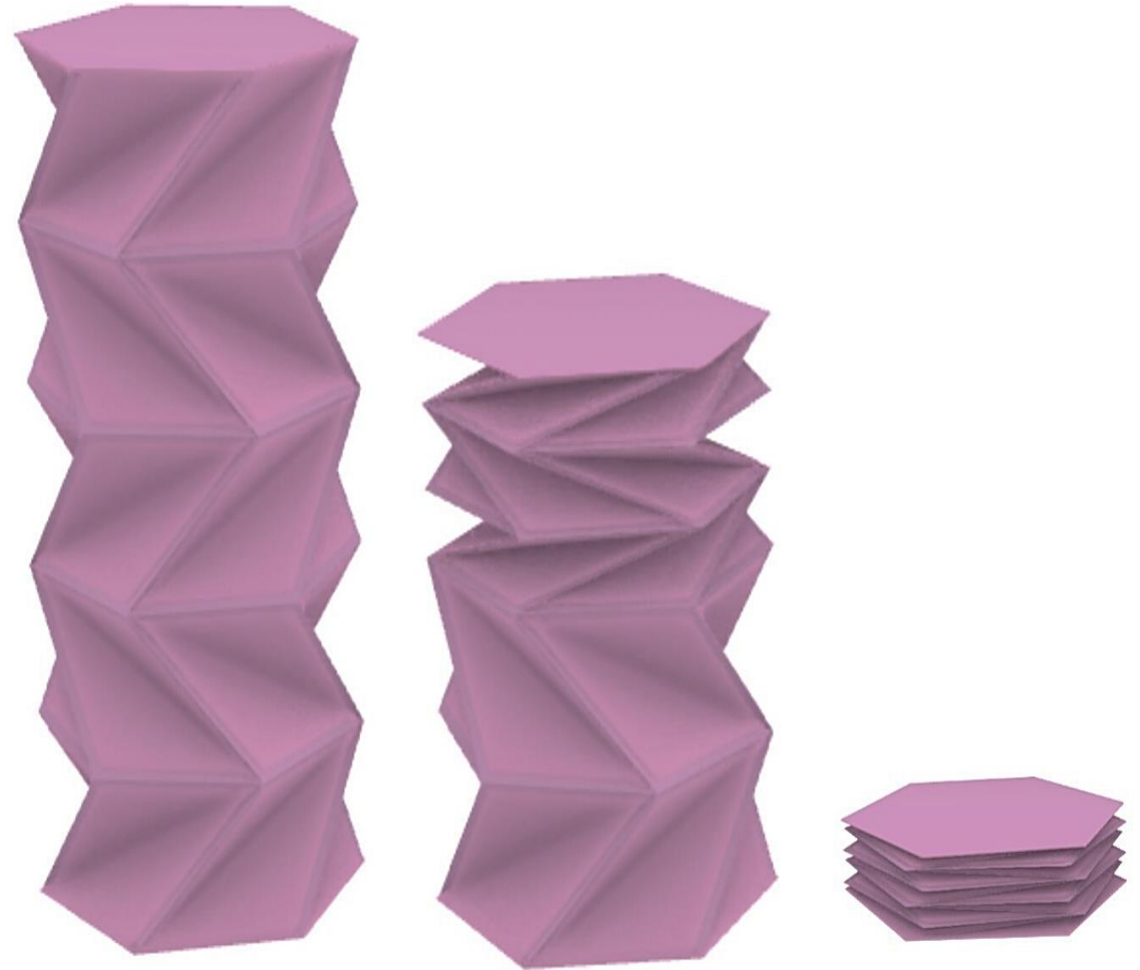
Ester Velázquez Navarro

Pablo Solano Lopez

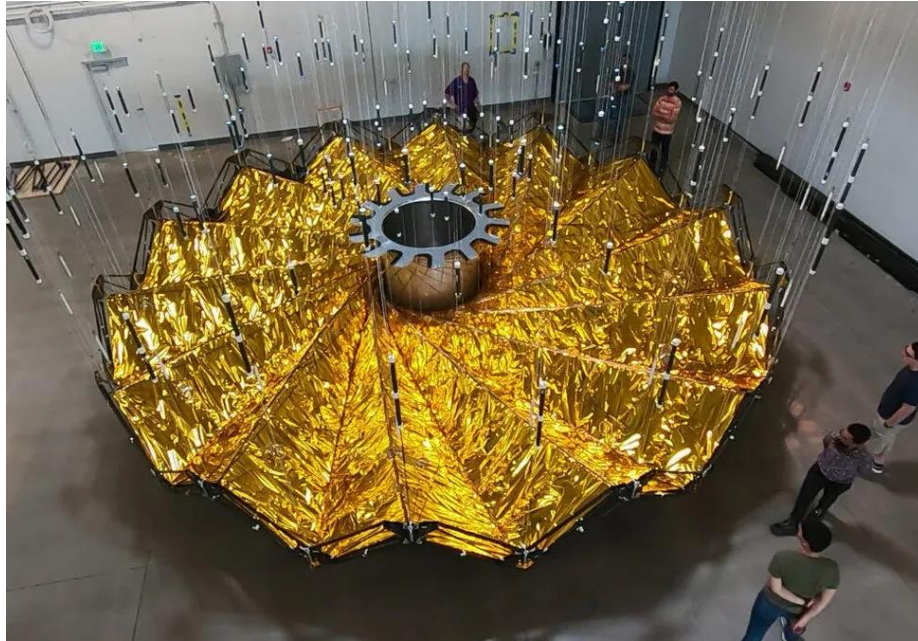
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 TU Delft

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# Origami-Inspired Structures

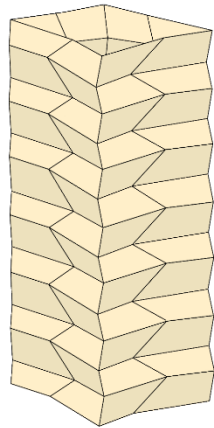
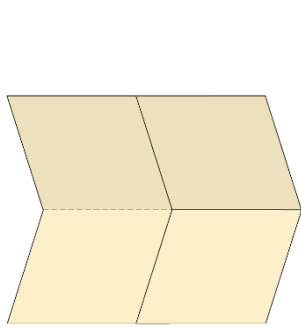


Credit: Starshade

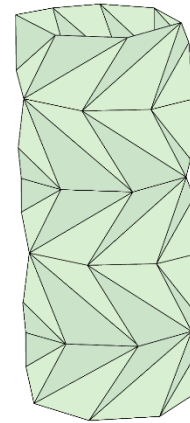
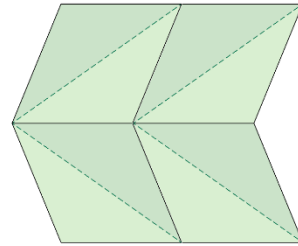


Credit: SAGA

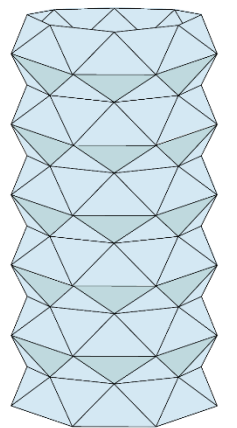
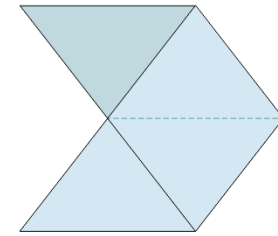
# Origami-Inspired Structures



Miura pattern



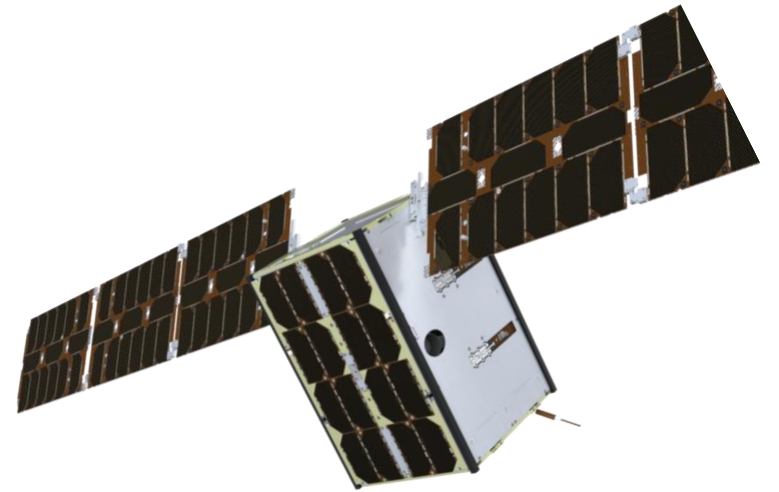
Kresling pattern



Yoshimura pattern

# Why a CubeSat Demonstrator?

- Small-scale proof-of-concept
- Explore the different technical solutions
- Explore manufacturing issues
- Raising the TRL



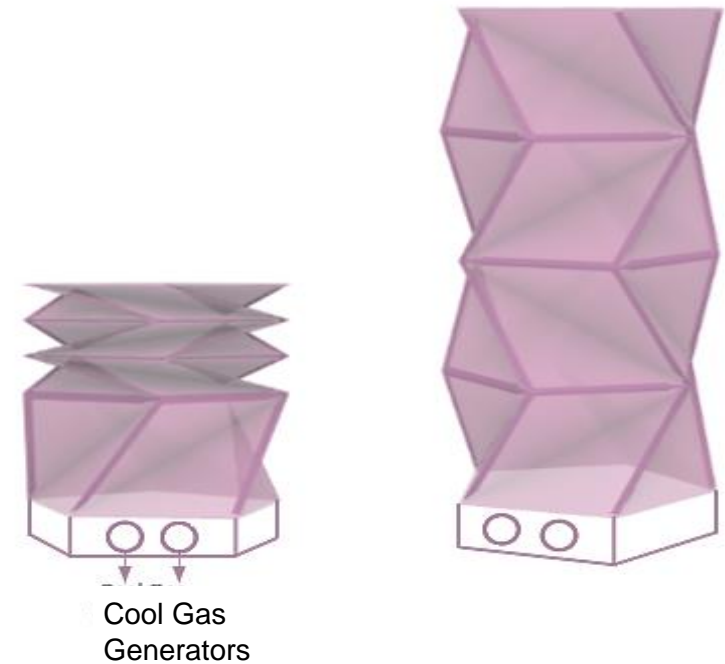
# Requirements

- Design
  - Fit within 12U CubeSat volume
  - High Deployment Ratio,  $\eta = \text{Deployed Volume} / \text{Folded Volume}$
- Structural Performance:
  - Withstand folding and deployment loads
  - Rigidity after deployment

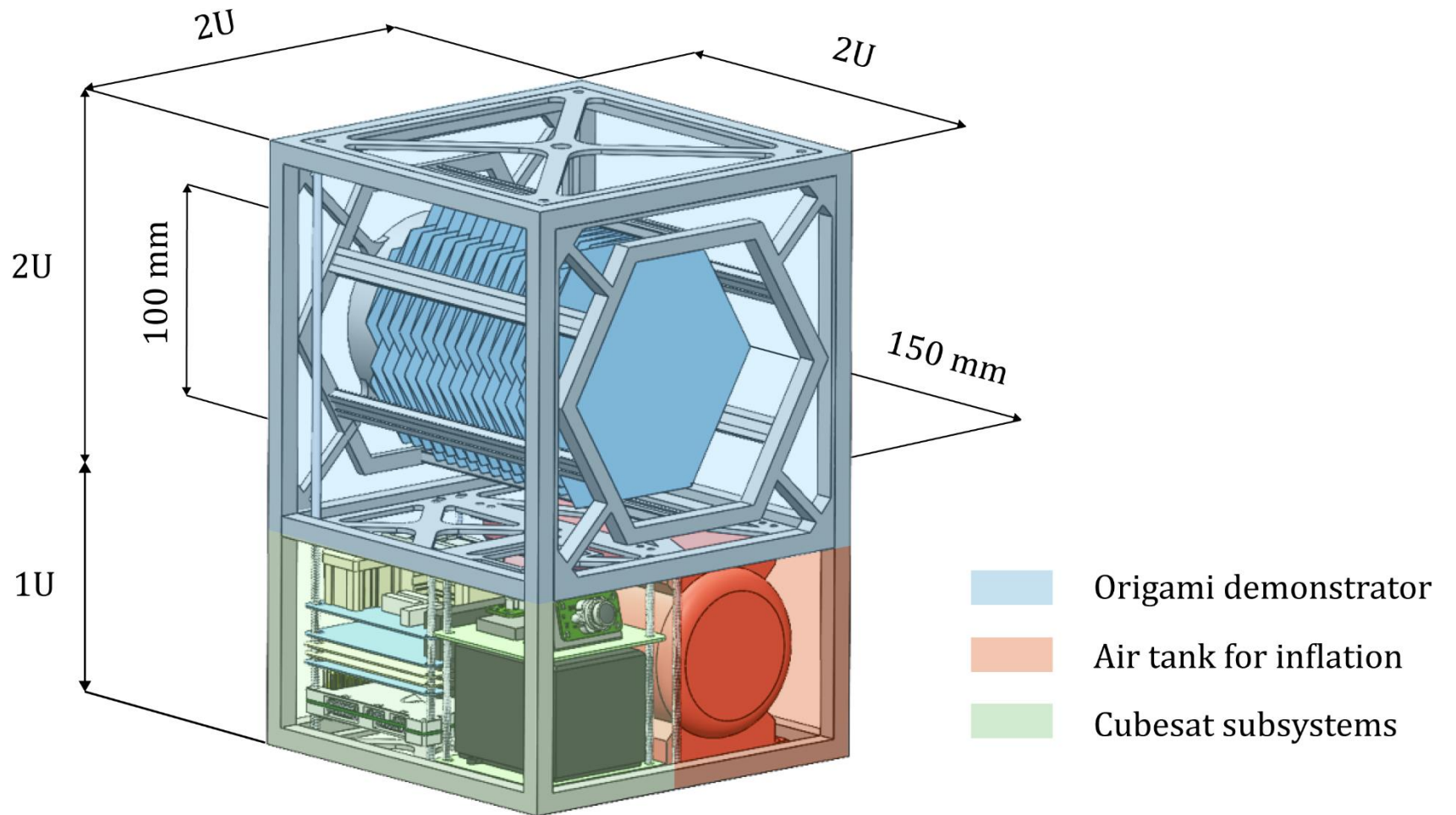
# Design Solution

**Kresling pattern made of dual-matrix composite with inflation deployment**

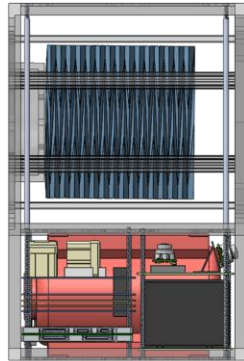
- + Lightweight
- + Few mechanical parts
- Not always retractable



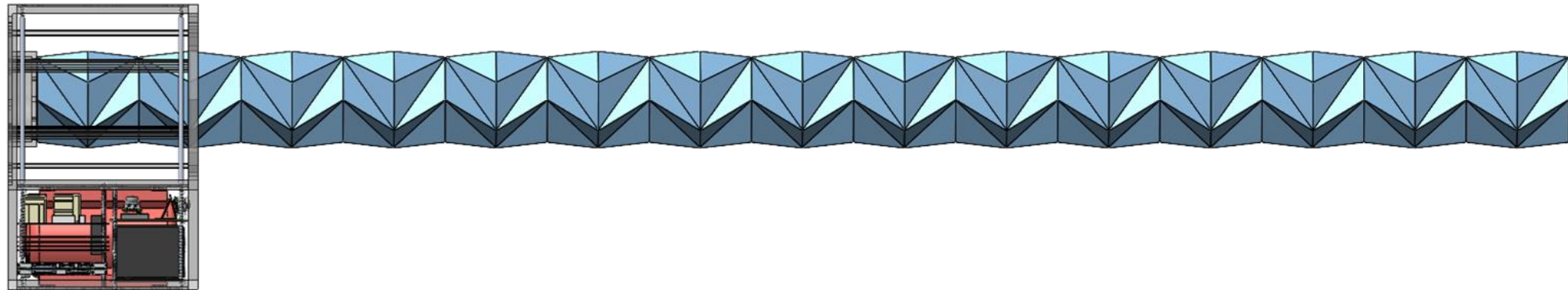
# Inflation Deployment



# Inflation Deployment

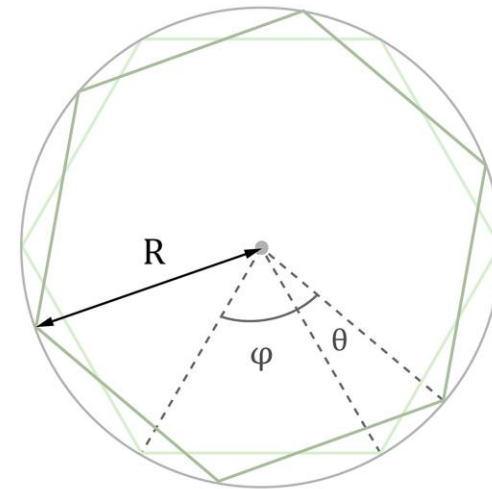
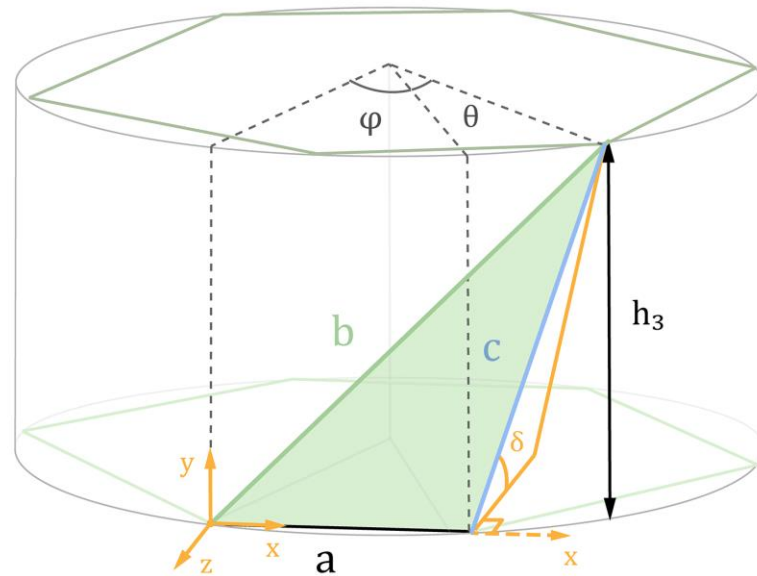
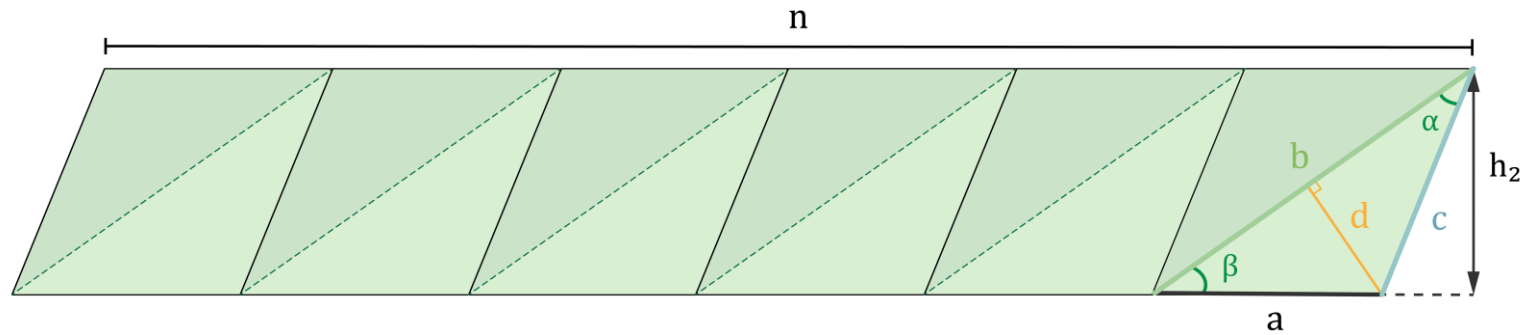


- Deployment by cool gas inflation
- Deployment ratio  $\approx 13$

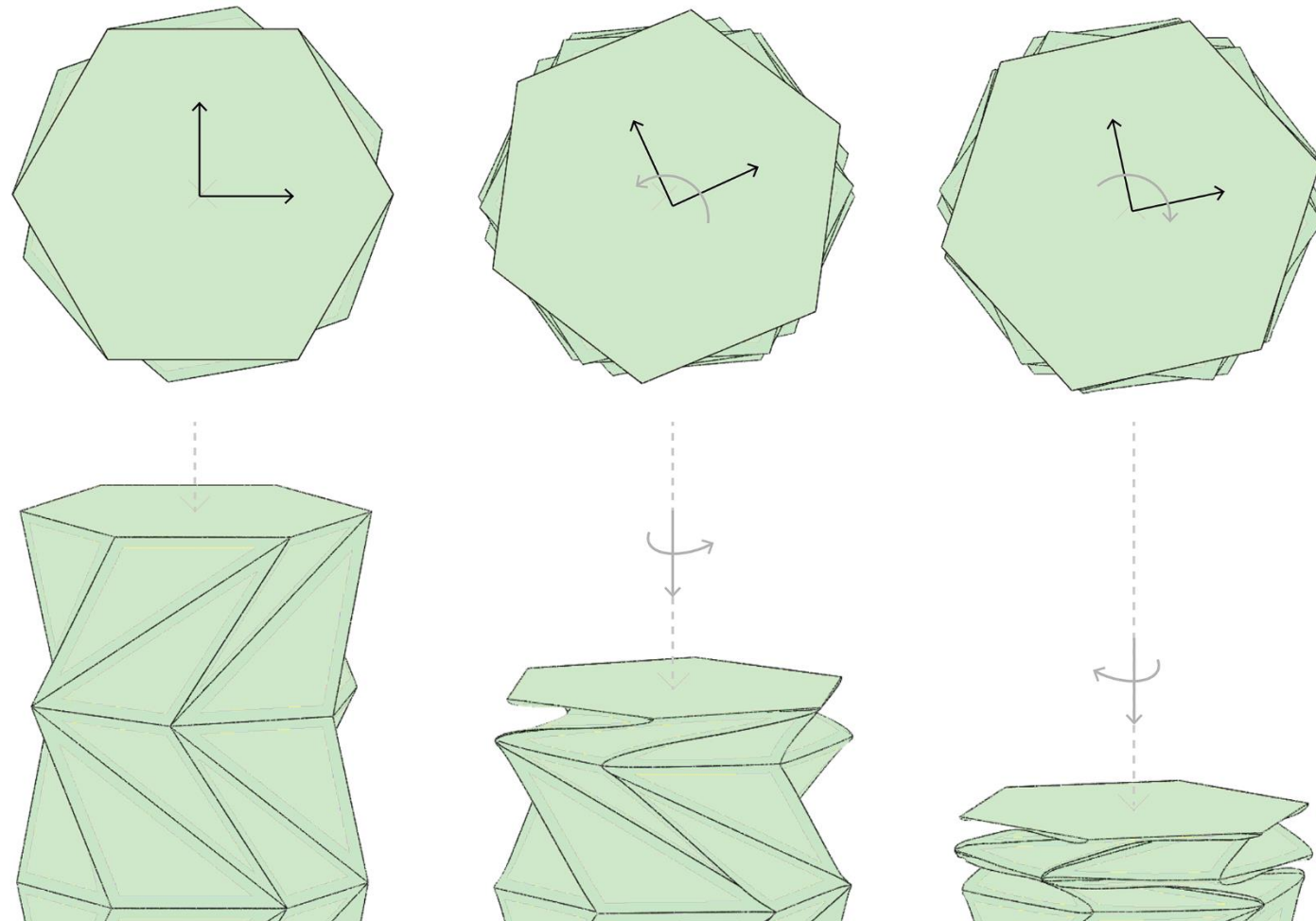




# Kresling Pattern



# Kresling Pattern

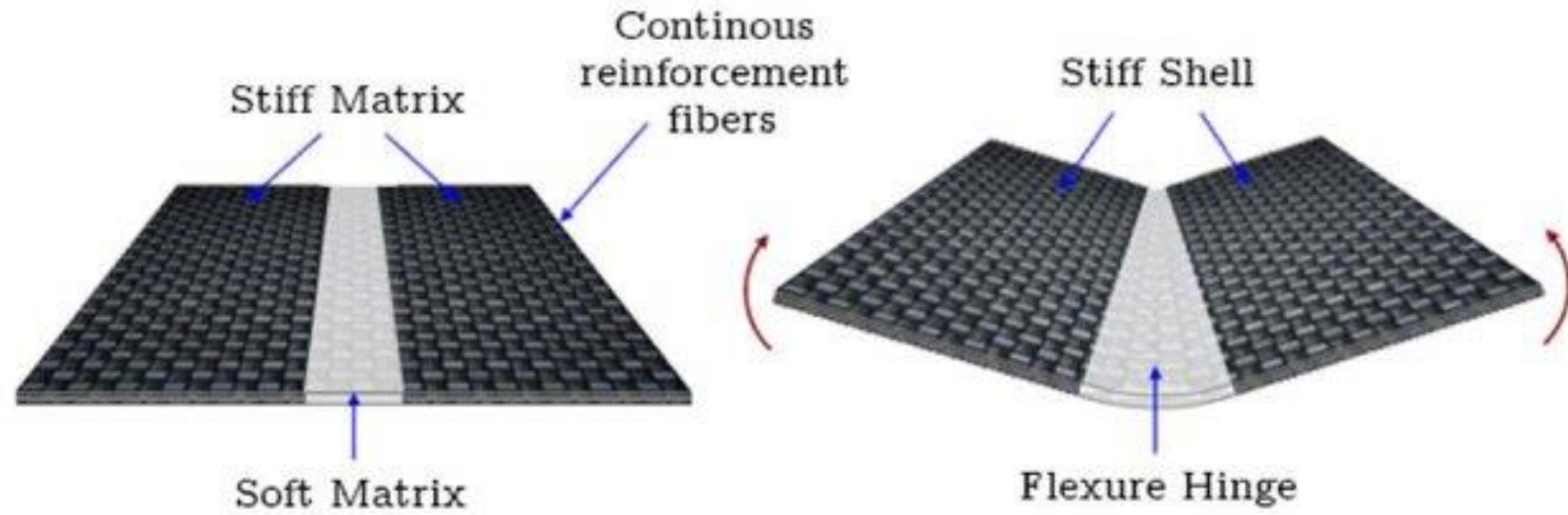


# Materials and Manufacturing



# Materials and Manufacturing

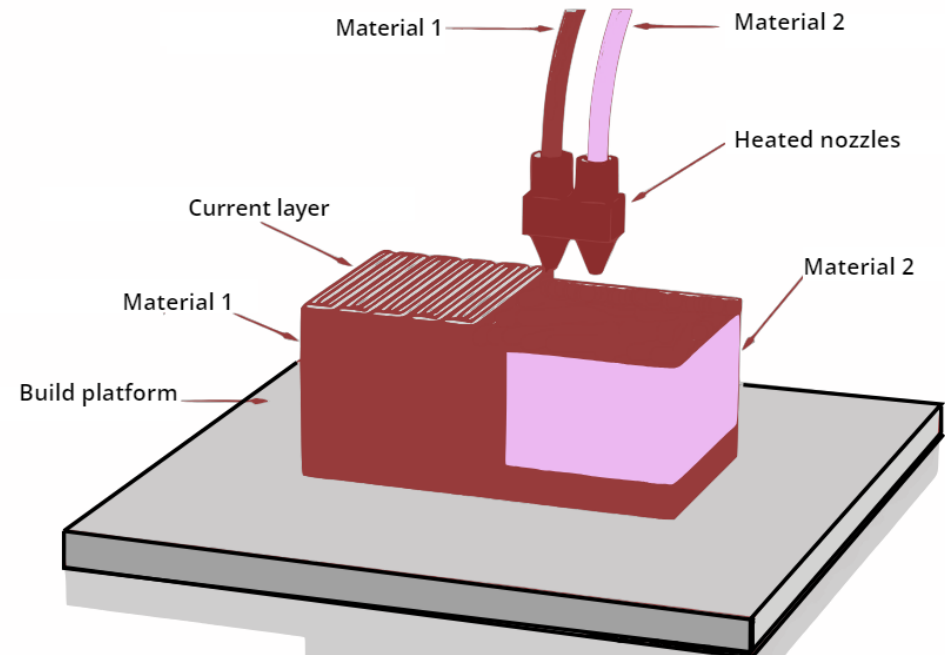
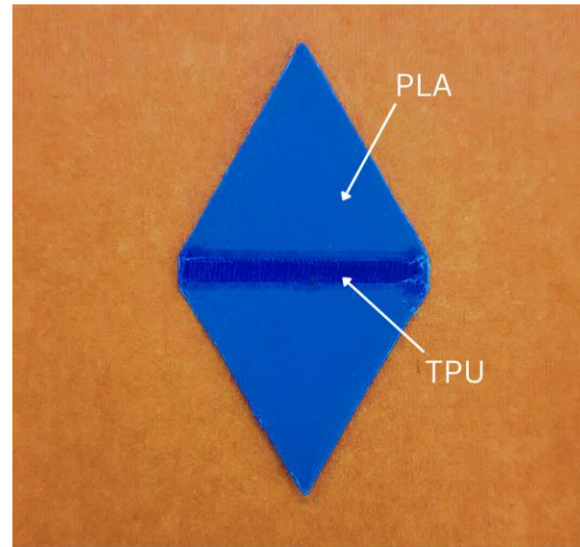
- Dual-Matrix composite material



[Sakovsky et al.\(2016\)](#)

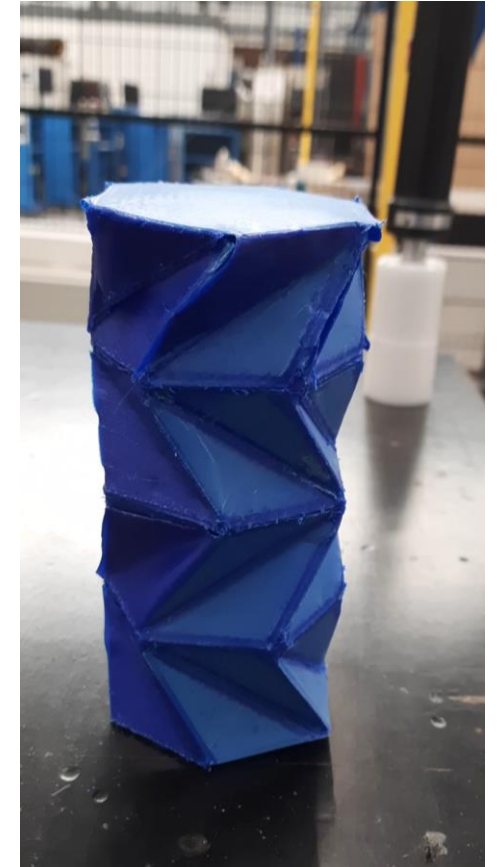
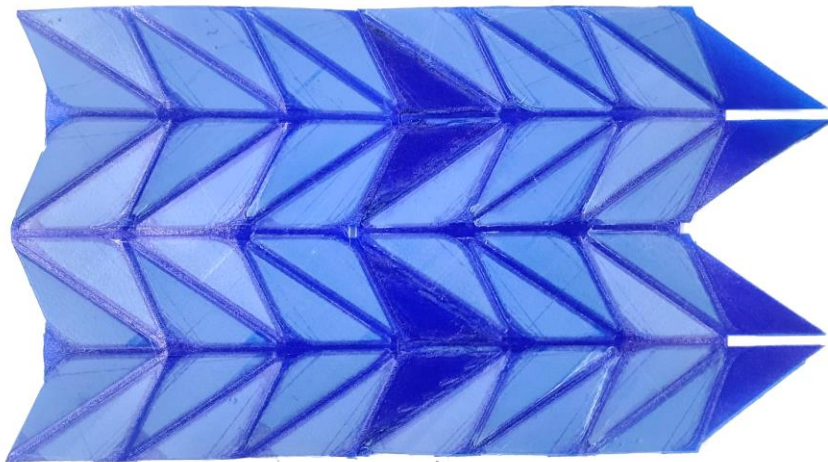
# Materials and Manufacturing

- 3D Printing with thermoplastic filaments



# Materials and Manufacturing

- 3D Printing with thermoplastic filaments



# Conclusions and next steps

- Suitable design fit for a CubeSat mission
- Optimal configuration for Kresling pattern
- Suitable manufacturing and prototyping techniques
- Ongoing: Manufacturing and testing optimal configuration

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