This course: *Focus on shape-changing metamaterials*

1. Intuitive examples and tool to characterize metamaterials (Tuesday)

2. Designing metamaterial using combinatorics (Wednesday)

3. Beyond the linear response, beyond the unit cell (today)

4. Active metamaterials (Friday)
Exercise of yesterday

https://uva-hva.gitlab.host/published-projects/CourseMechanicalMetamaterials
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1. Intuitive examples and tool to characterize metamaterials (Tuesday)

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3. **Beyond the linear response, beyond the unit cell** (today)

4. Active metamaterials (Friday)
Mechanisms

Grima and Evans Mat. Sc. 2000

Florijn et al. PRL 2014

Dressed mechanisms
Dressed mechanisms
Programmability

Linear Elasticity

Asymmetry -> Control Nonlinear Response

Force

Displacement

y

x
Programmability

Linear Elasticity

Asymmetry -> Control Nonlinear Response

Displacement

Force

\[ u_x, u_y, F \]
Programmability

Linear Elasticity

Asymmetry $\rightarrow$ Control Nonlinear Response

(2016) Soft Matter

Displacement vs. Force
Dressed mechanisms
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Deformations: Conformal maps

\[ E = \int d^2 r \frac{1}{2} \left[ \frac{\beta^2}{a^2} M(\alpha) + a^2 \tilde{M}(\alpha) |\nabla \alpha|^2 \right] \]

Czajkowski et al. Nat. Comm. 2022
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Buckling of frustrated metamaterials

Guo, Guzman, Carpentier, Bartolo, Coulais arXiv:2111.13933
Buckling of frustrated metamaterials

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Even-odd metatorus

$N_t \text{ even}$

$N_p \text{ odd}$

10 mm

Guo, Guzman, Carpentier, Bartolo, Coulais arXiv:2111.13933