mecanon
Center for Nonlinear Mechanics
COPPE-POLI|UFRJ

COM783 – Mecânica de Sistemas Inteligentes: Materiais Inteligentes e Suas Aplicações

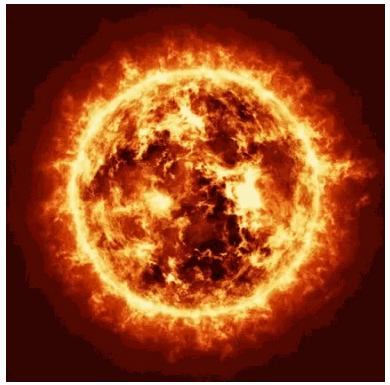
Prof. Luã G. Costa

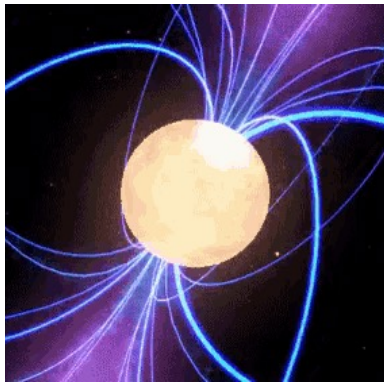
Universidade Federal do Rio de Janeiro (COPPE/UFRJ)

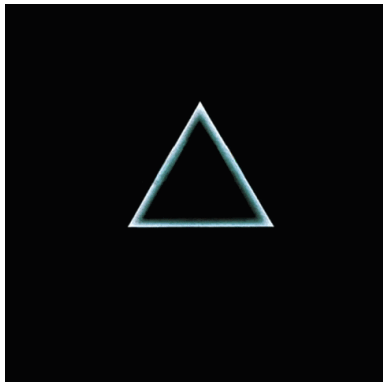
Programa de Engenharia Mecânica (PEM)

Materiais Inteligentes: Acomplamento Multifísico

Mecânico | Térmico | Elétrico | Magnético | Óptico





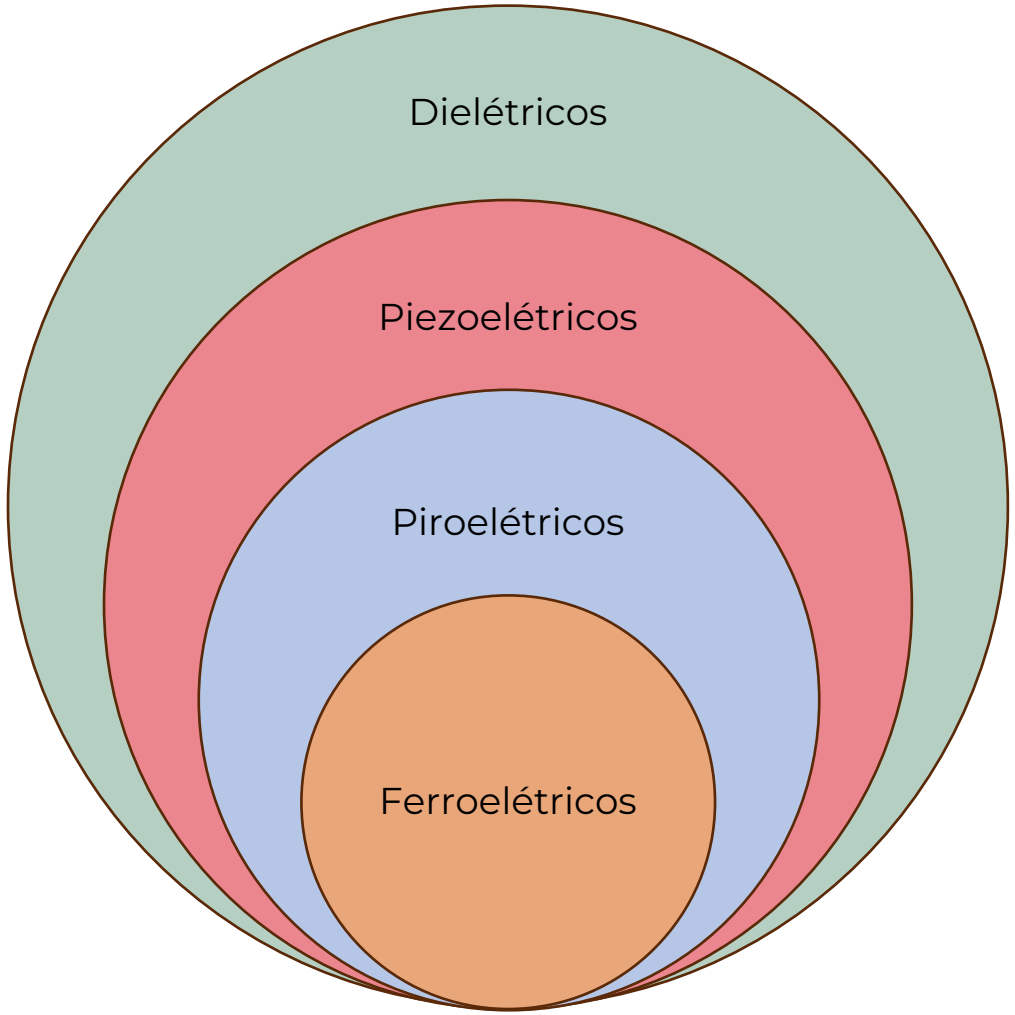


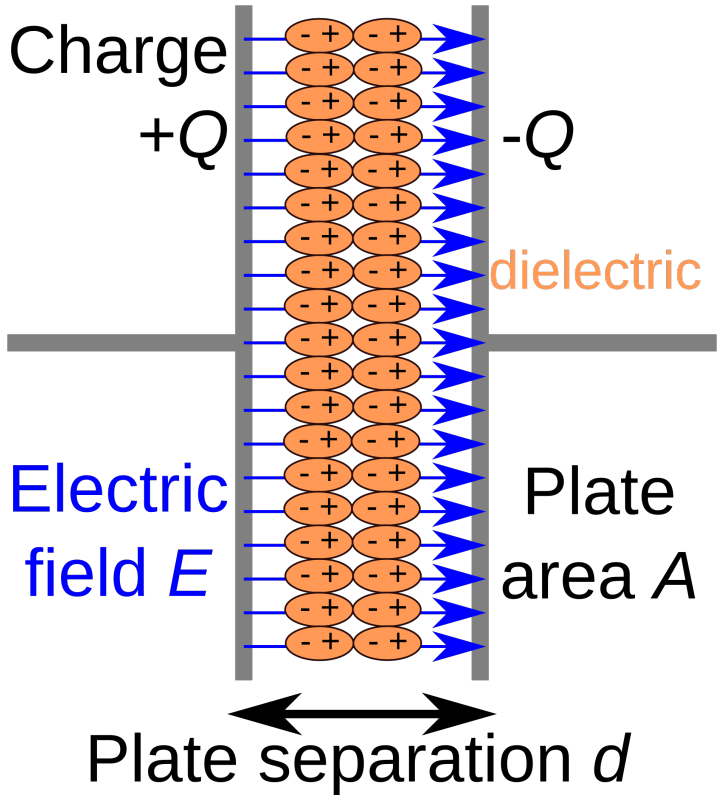
Piezoelétricos

Elastômeros Dielétricos / Eletroestrictivos

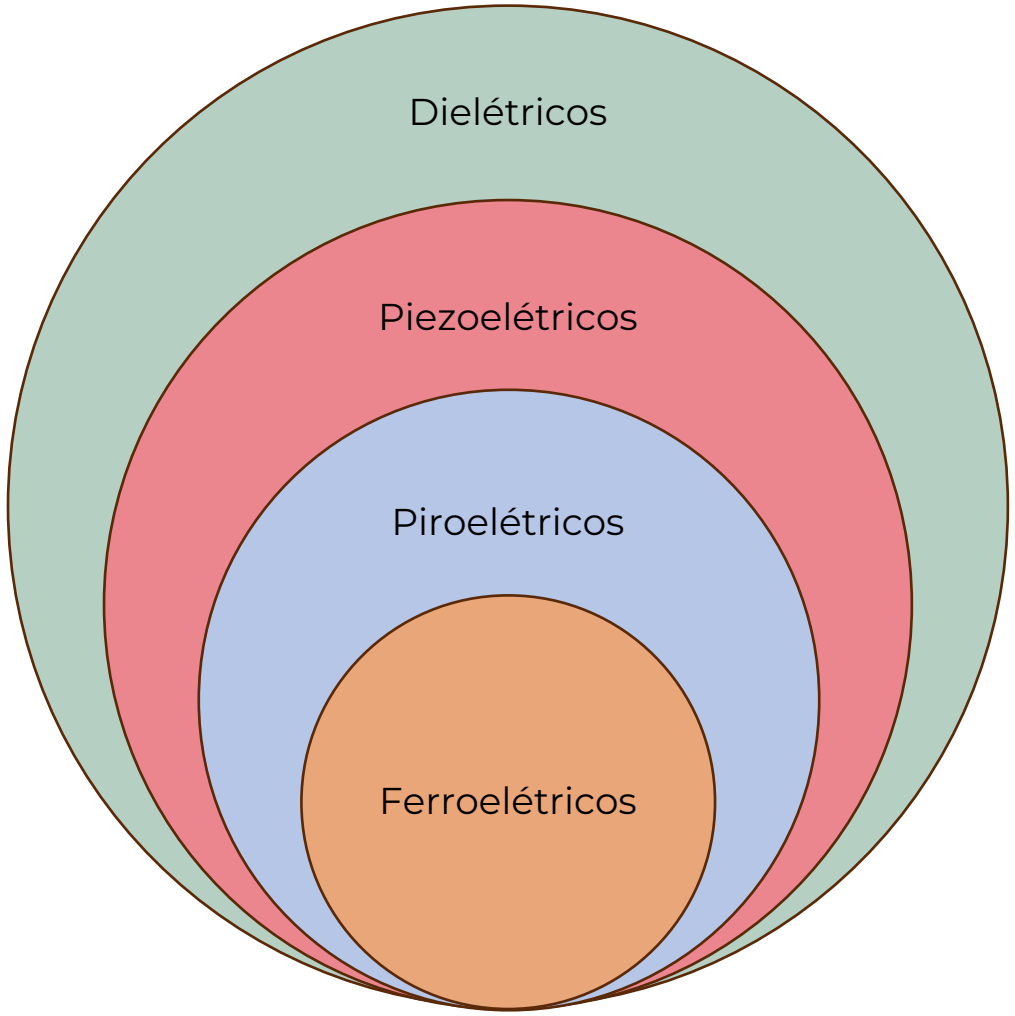
Fluidos Eletroreológicos

Materiais Dielétricos

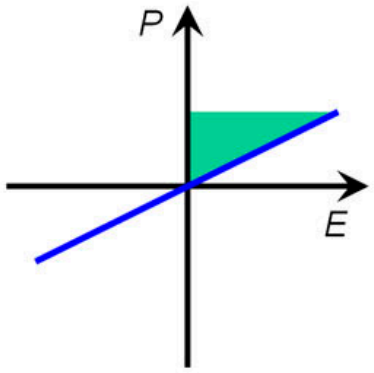


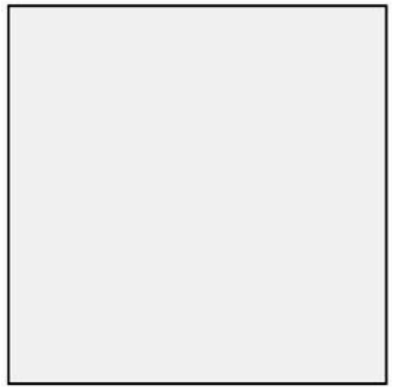


Materiais Dielétricos

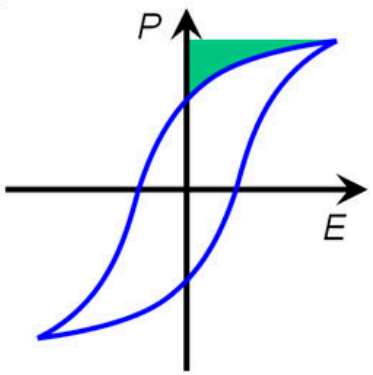


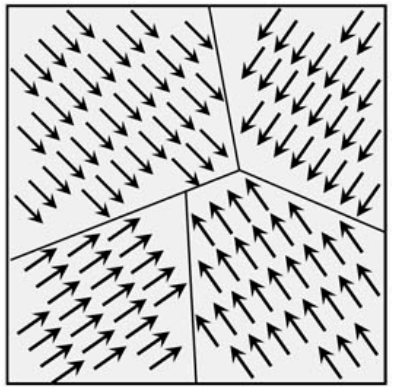
Dielétrico



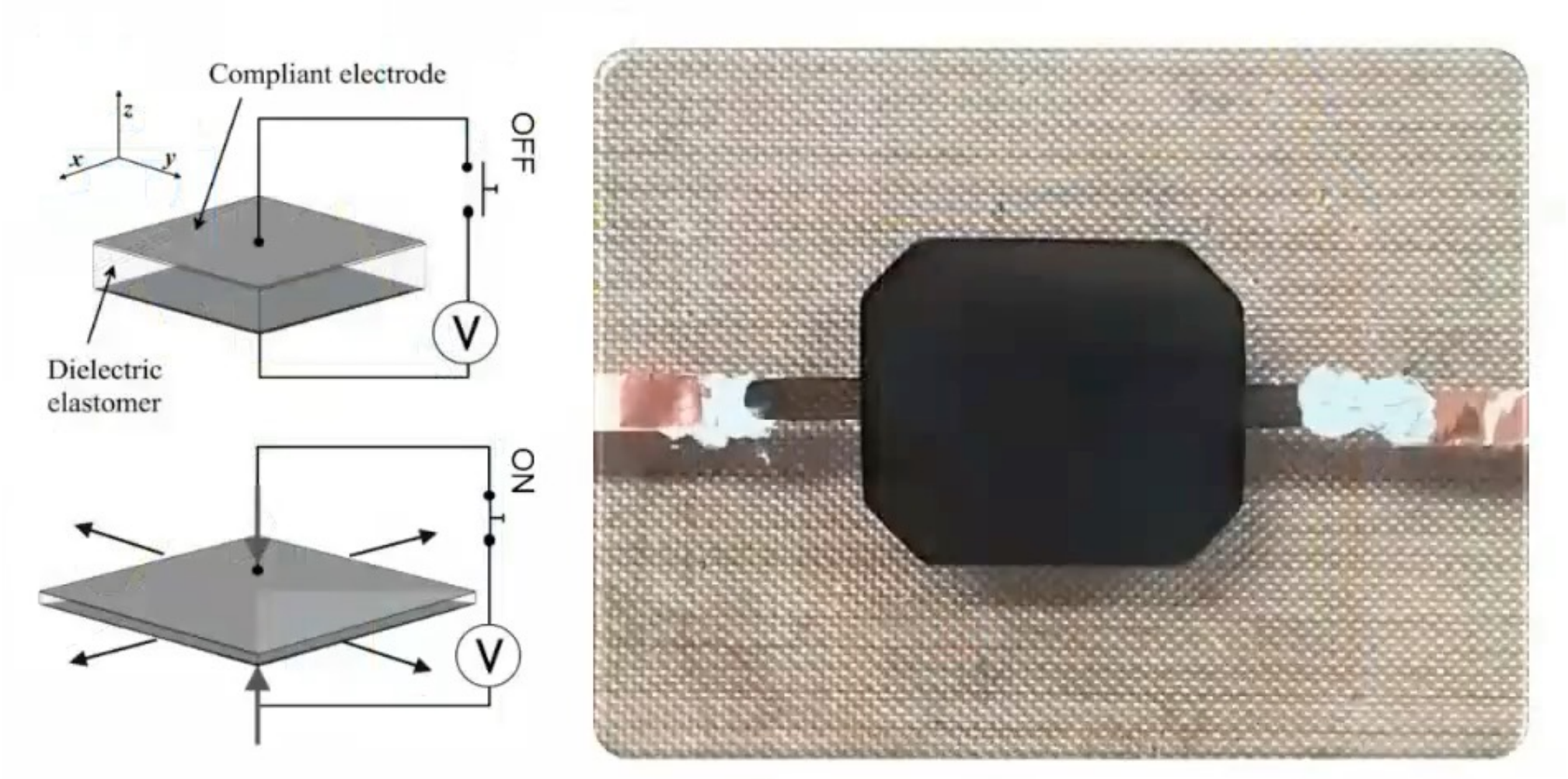


Ferroelétrico



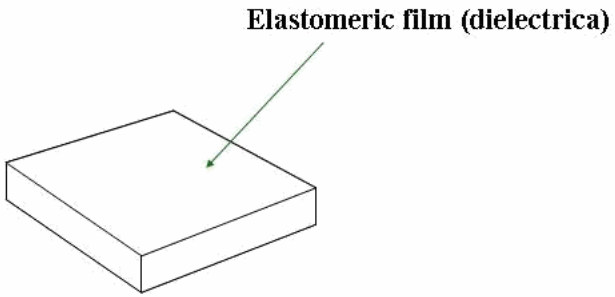


Elastômeros Dielétricos – Princípio de Funcionamento



Atração mútua entre os eletrodos, causando o chamado estresse de Maxwell.

Elastômeros Dielétricos



High-Speed Electrically Actuated Elastomers with Strain Greater Than 100%

Ron Pelrine,* Roy Kornbluh, Qibing Pei, Jose Joseph

Ronald Pelrine	Roy Kornbluh	Qibing Pei	Jose Joseph
			?

Elastômeros Dielétricos

Acrílicos

VHB 4905
VHB 4010
(3M)

Silicones

CF 19-2186
(NuSil)

Borracha Natural

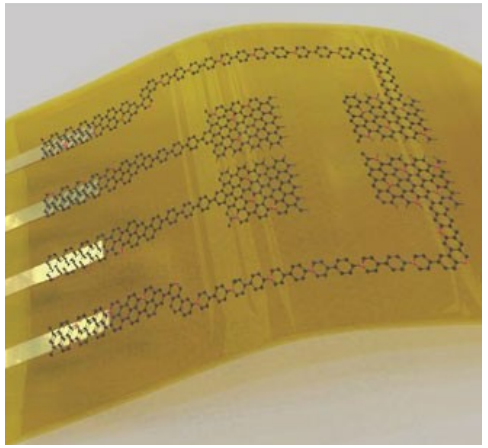
Poliuretanos (PUs)

Elastômeros Dielétricos - Eletrodos

- Altamente extensíveis
- Flexível
- Condutivos
- Suportar muitos ciclos

Graxa de Carbono

Grafeno



Borracha Condutora

Pó de Carbono

Nanotubos de Carbono

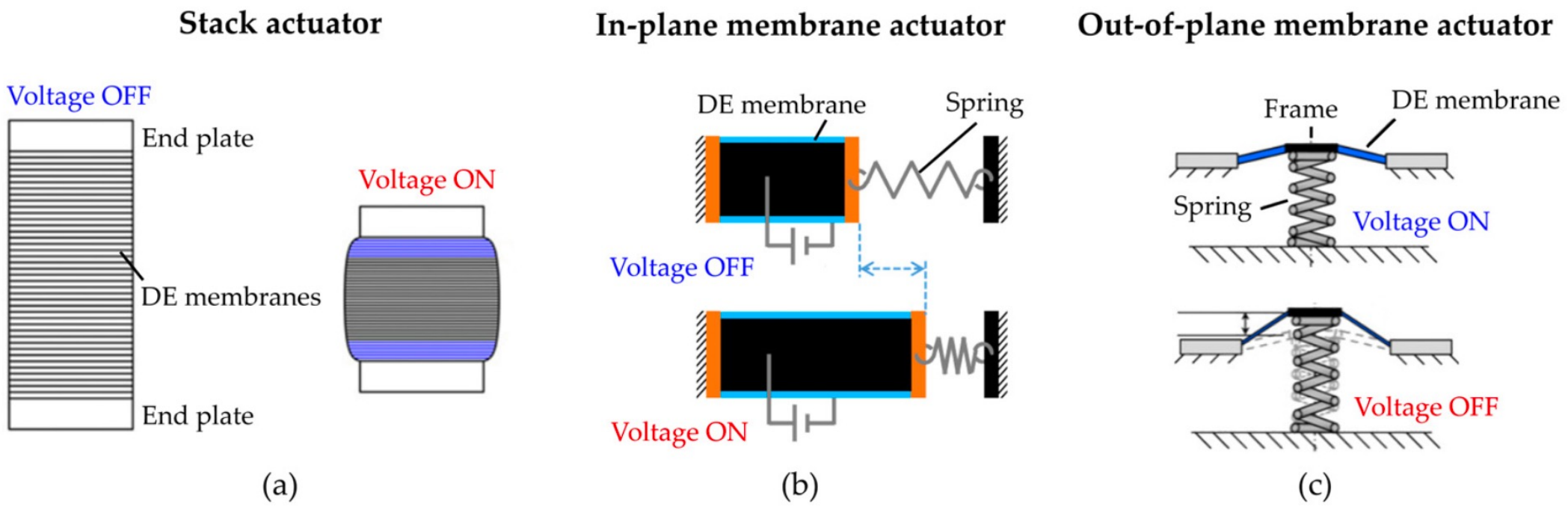
Elastômeros Dielétricos - Atuadores

Table 1. Comparison of natural muscle and man-made actuator technologies (note: electromagnetic and magnetostrictive technologies are efficient at high speeds, but inefficient at low speeds–hence their poor speed rating).

Actuator	Strain	Actuation Pressure	Density	Efficiency	Speed (fast AND slow)
Natural Muscle	●	●	●	●	●
Electromagnetic	●	●	○	●	○
Piezoelectric	○	●	◑	●	●
Shape Memory Alloy	◑	●	◑	○	○
Magnetostrictive	○	●	○	●	○
Electrostatic	●	○	●	●	●
Dielectric Elastomers	●	●	●	●	●
○ = Poor		◑ = Fair		● = Good	

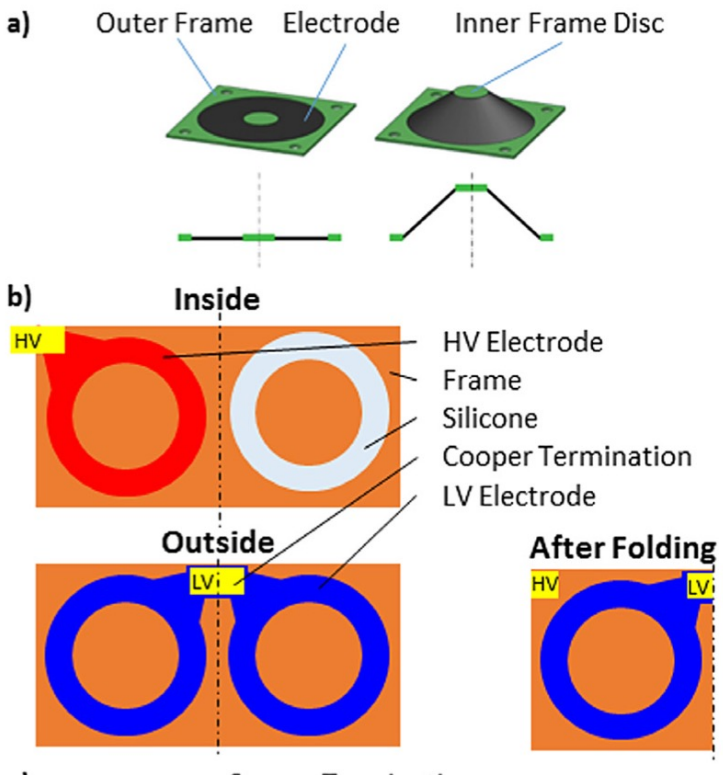
Pelrine et al. (2002)

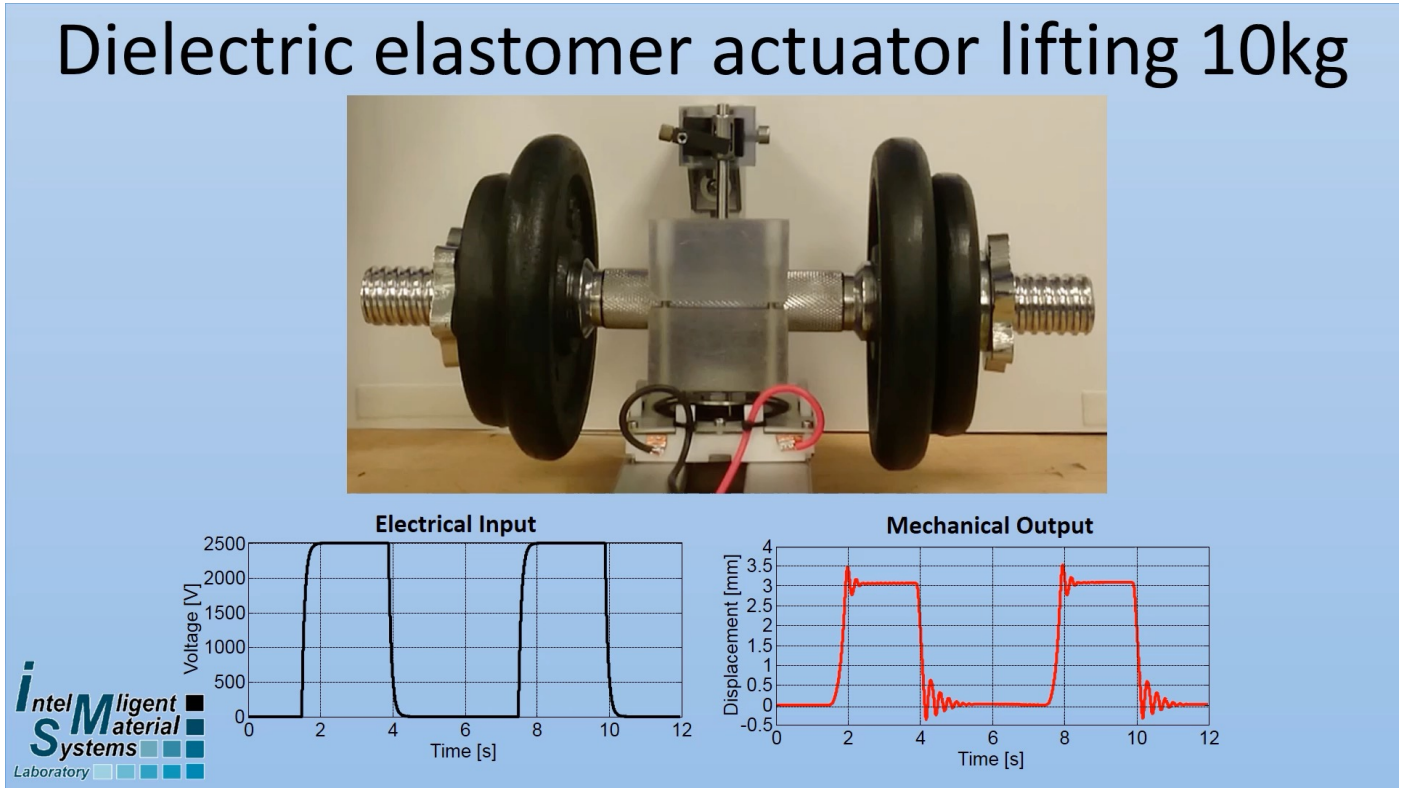
Elastômeros Dielétricos - Atuadores



Rizzello (2023)

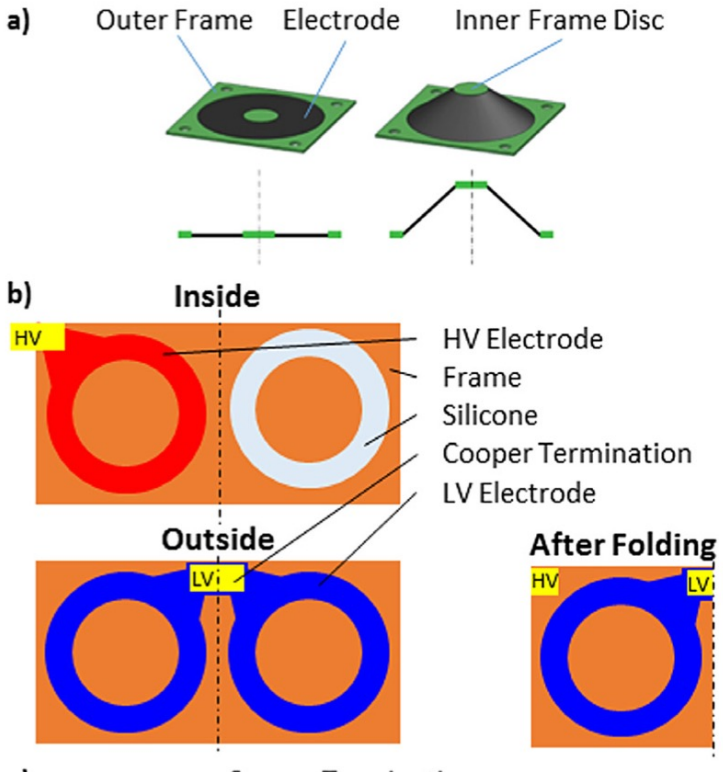
Elastômeros Dielétricos - Atuadores

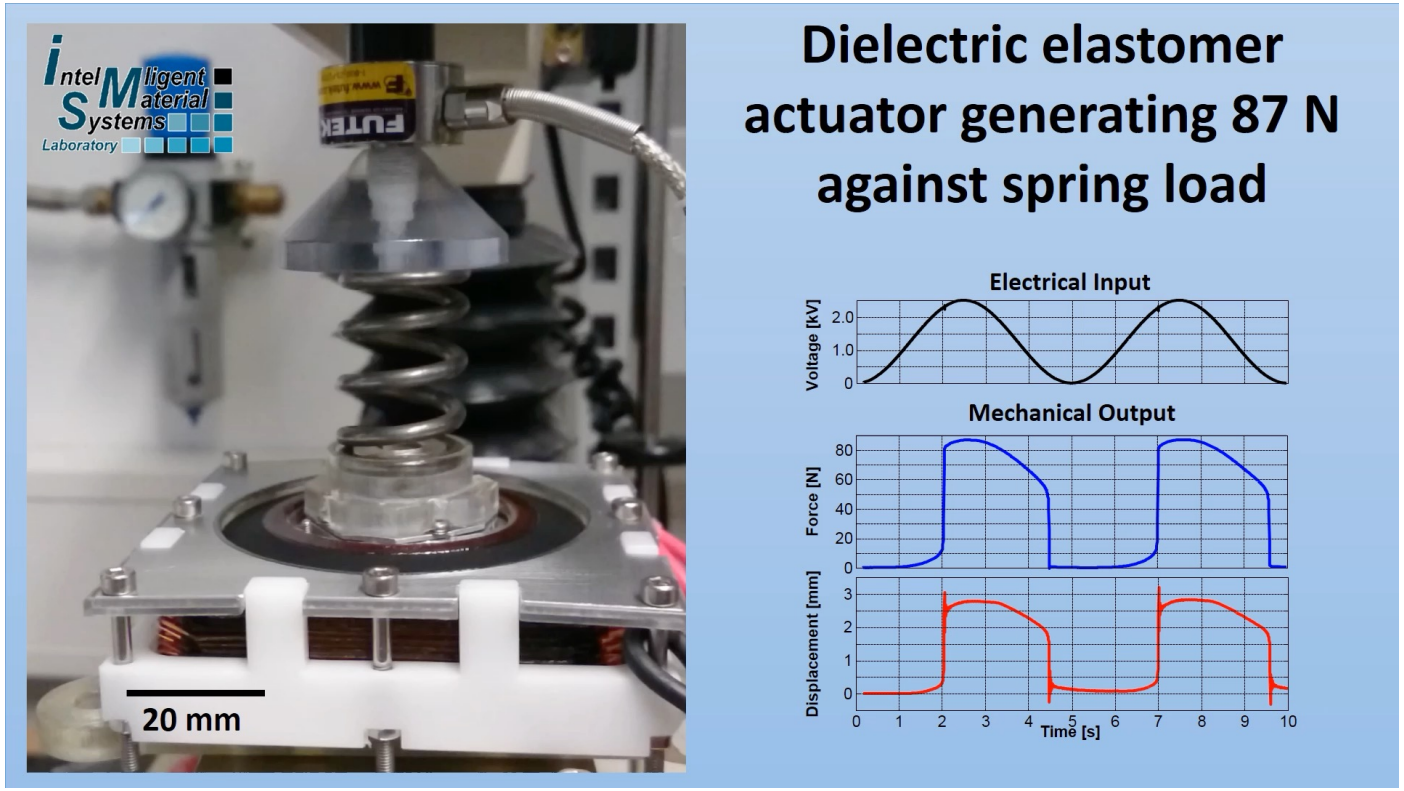




Hau et al. (2018)

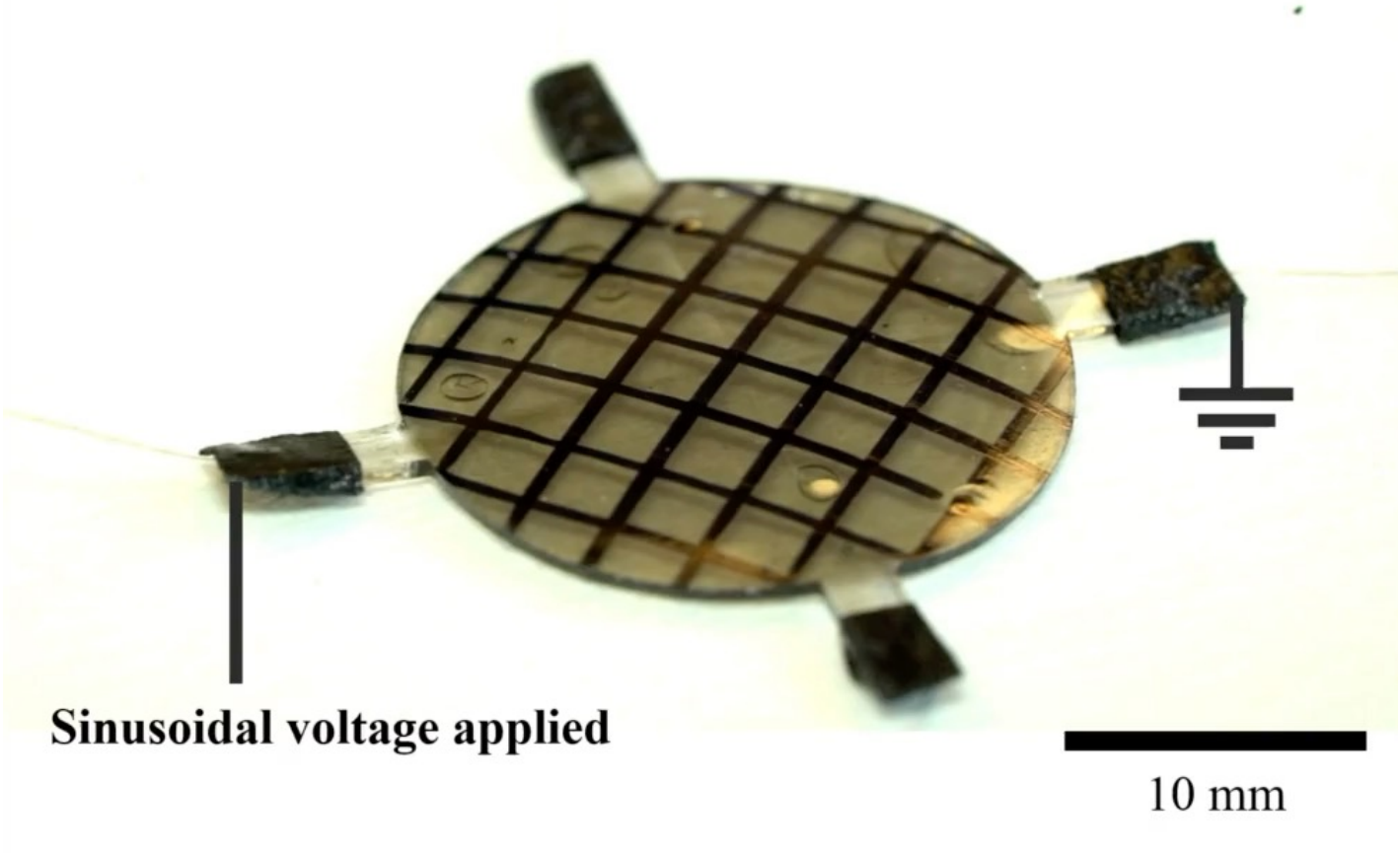
Elastômeros Dielétricos - Atuadores





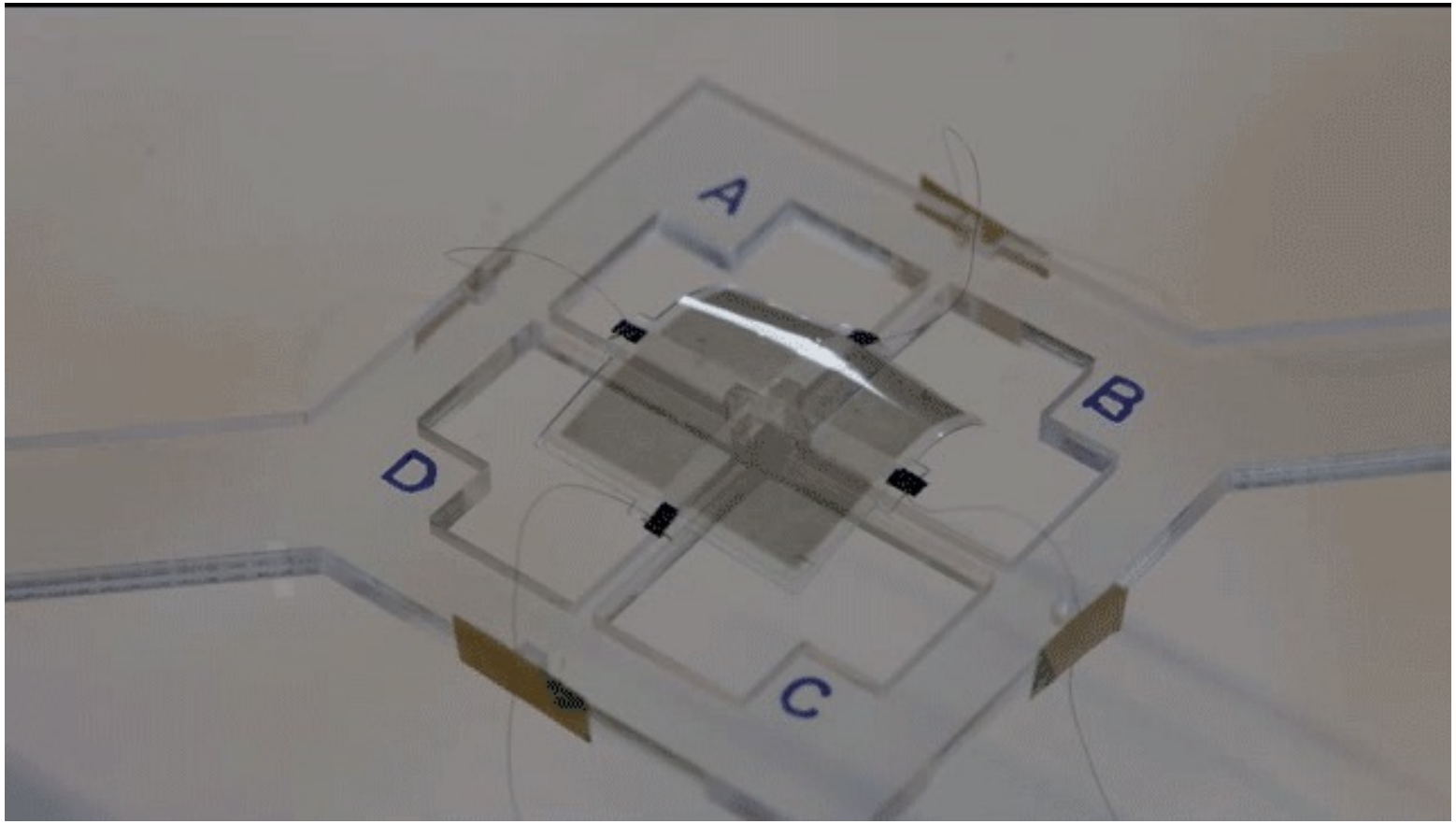
Hau et al. (2018)

Elastômeros Dielétricos - Atuadores



Hajiesmaili & Clarke (2019)

Elastômeros Dielétricos - Atuadores



Duduta et al. (2016)

Elastômeros Dielétricos - Atuadores

Shian et al. (2015)

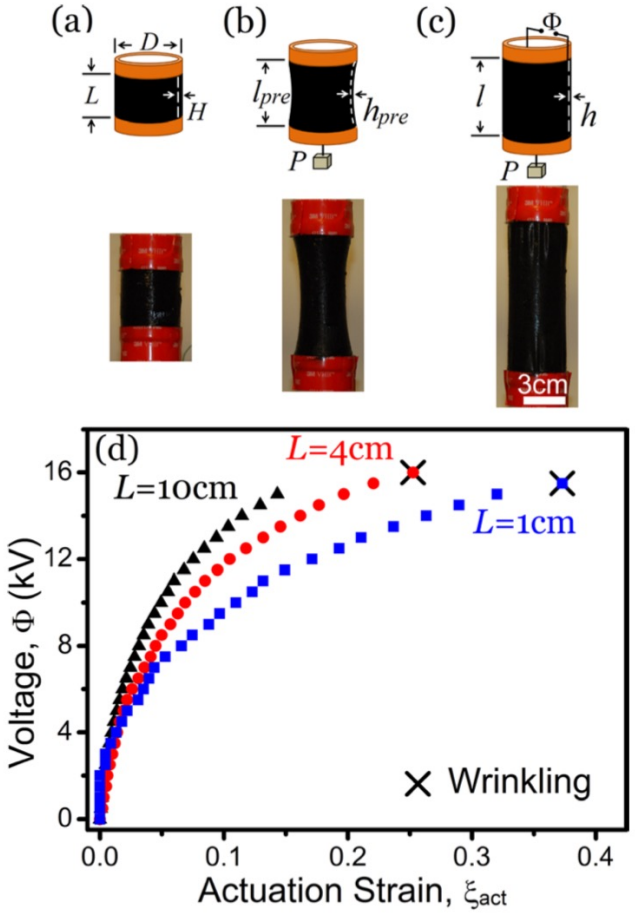
Elastômeros Dielétricos - Atuadores

Shian et al. (2015)

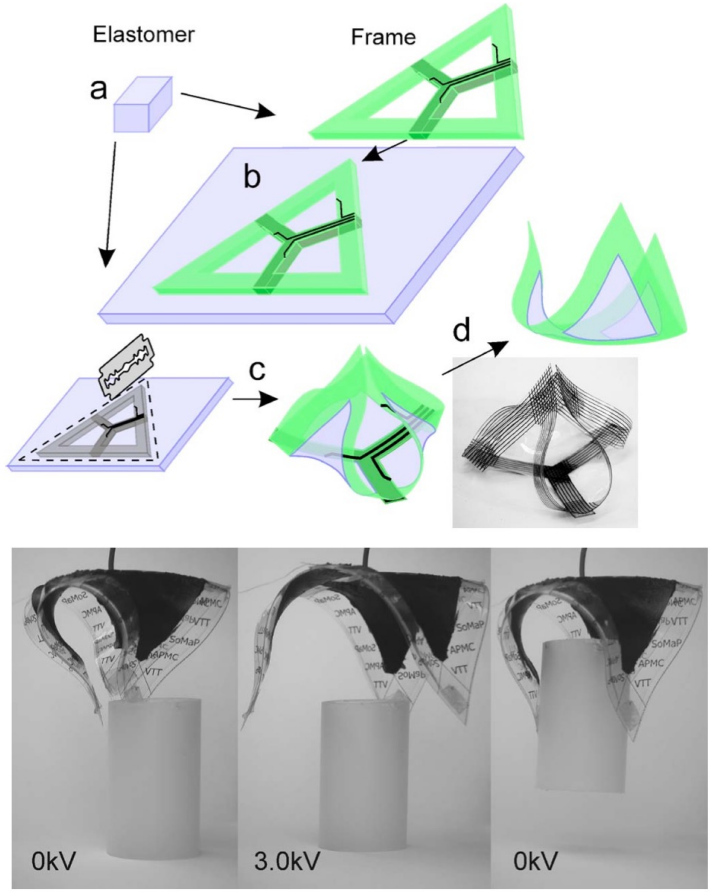
Elastômeros Dielétricos - Atuadores

Shian et al. (2015)

Elastômeros Dielétricos - Atuadores

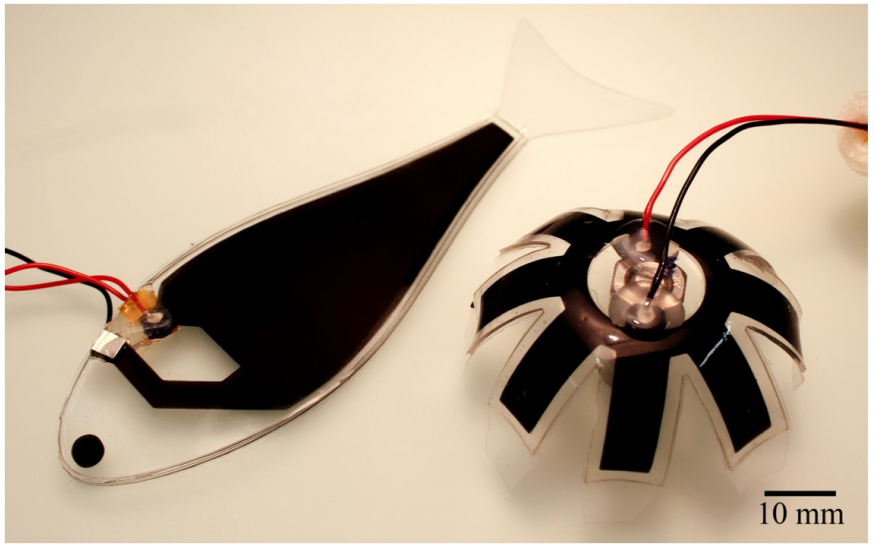


Huang et al. (2012)



Kofod et al. (2007)

Elastômeros Dielétricos - Atuadores



Biomimetic underwater robots based on dielectric elastomer actuators

Jun Shintake*, Herbert Shea**, and Dario Floreano*

École Polytechnique Fédérale de Lausanne
*Laboratory of Intelligent Systems
**Microsystems for Space Technologies Laboratory

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

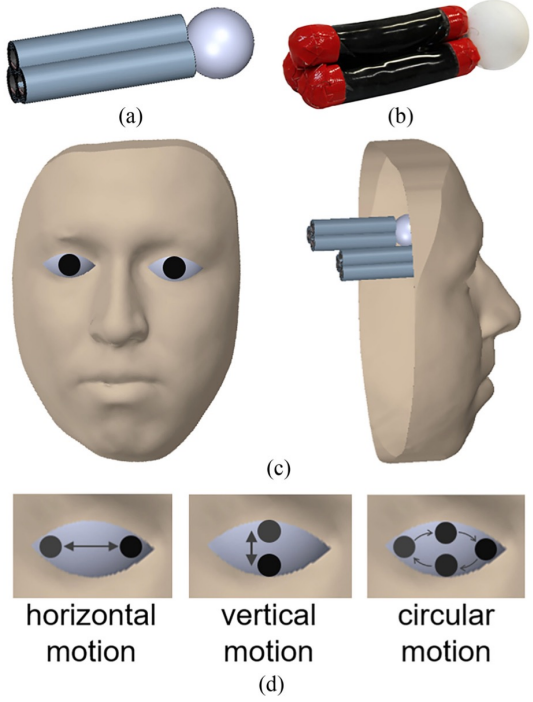
robotics

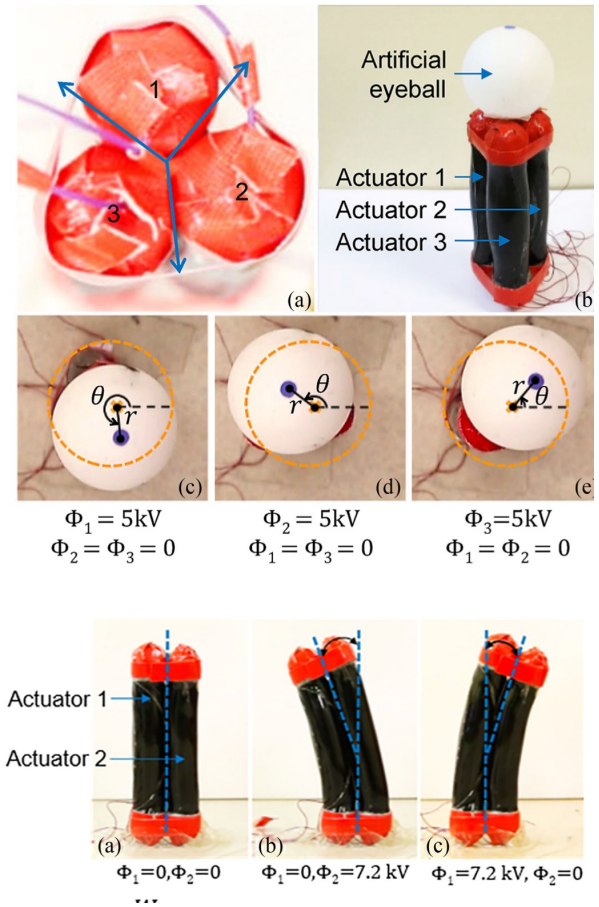
Swiss National Centre of Competence in Research

FNSNF

Shintake et al. (2016)

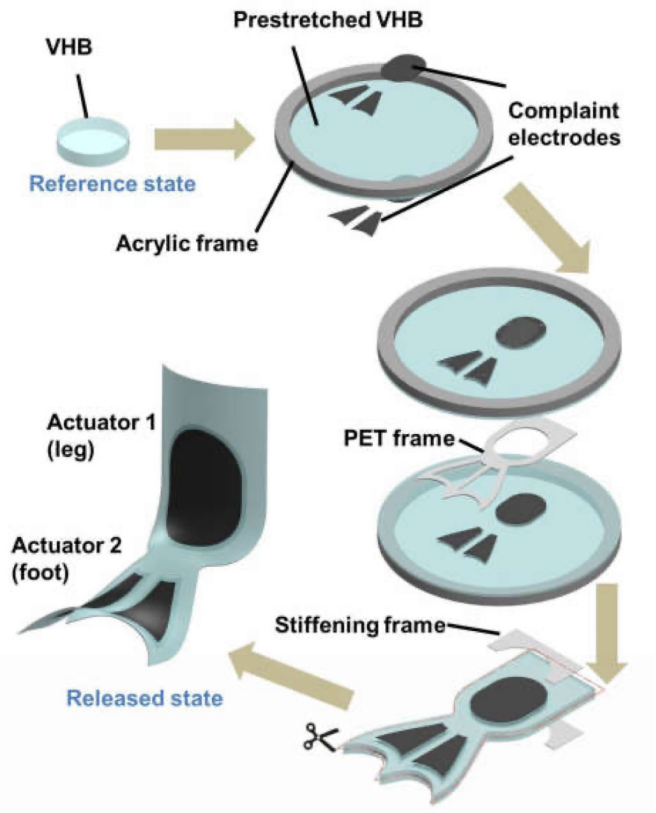
Elastômeros Dielétricos - Atuadores

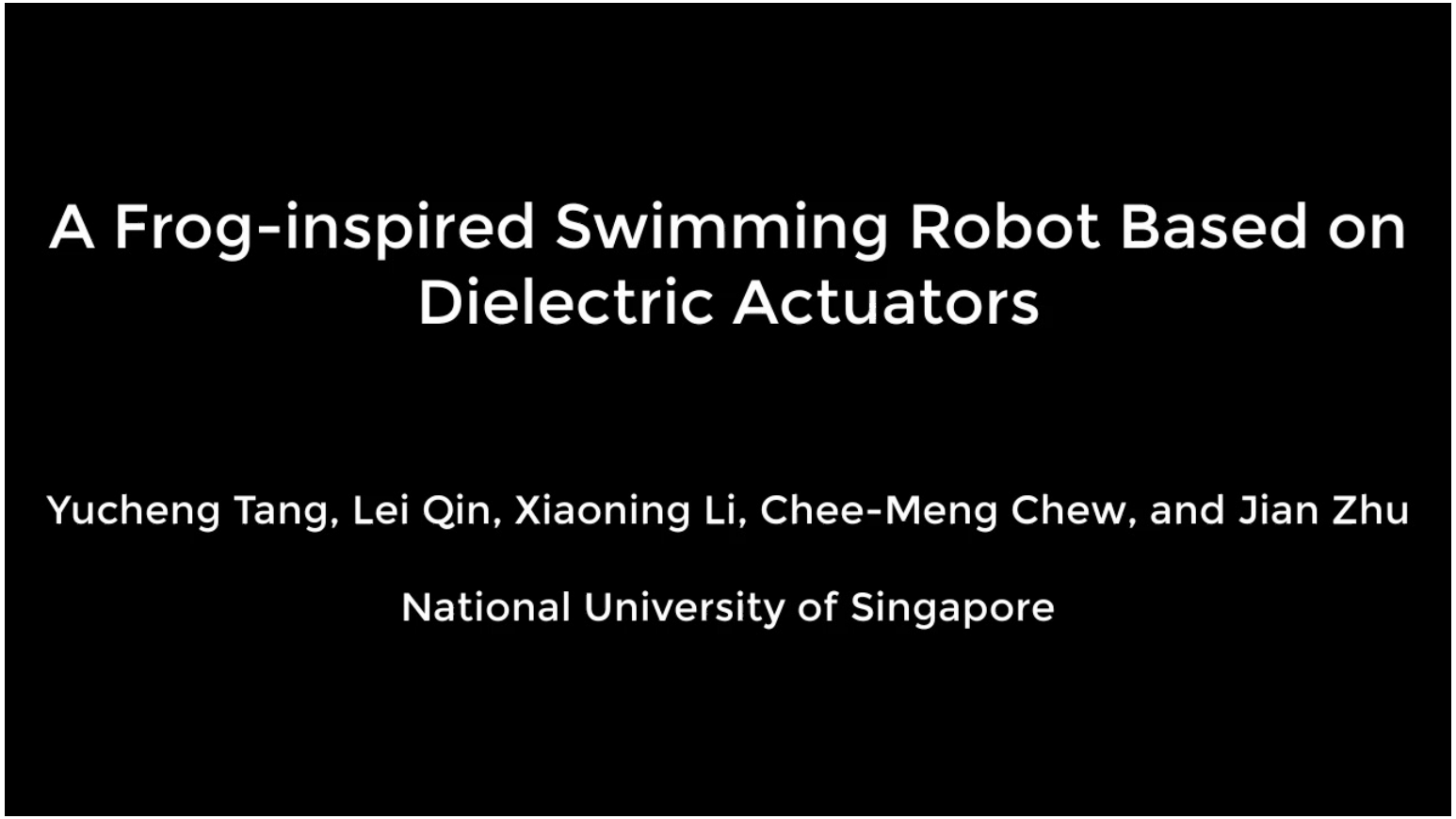




Li et al. (2019)

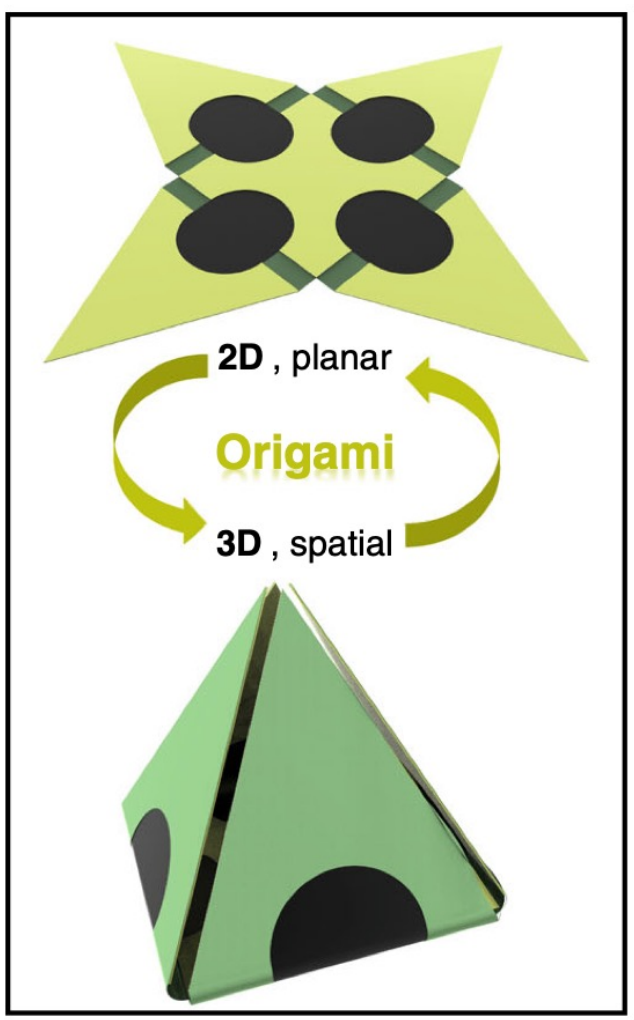
Elastômeros Dielétricos - Atuadores

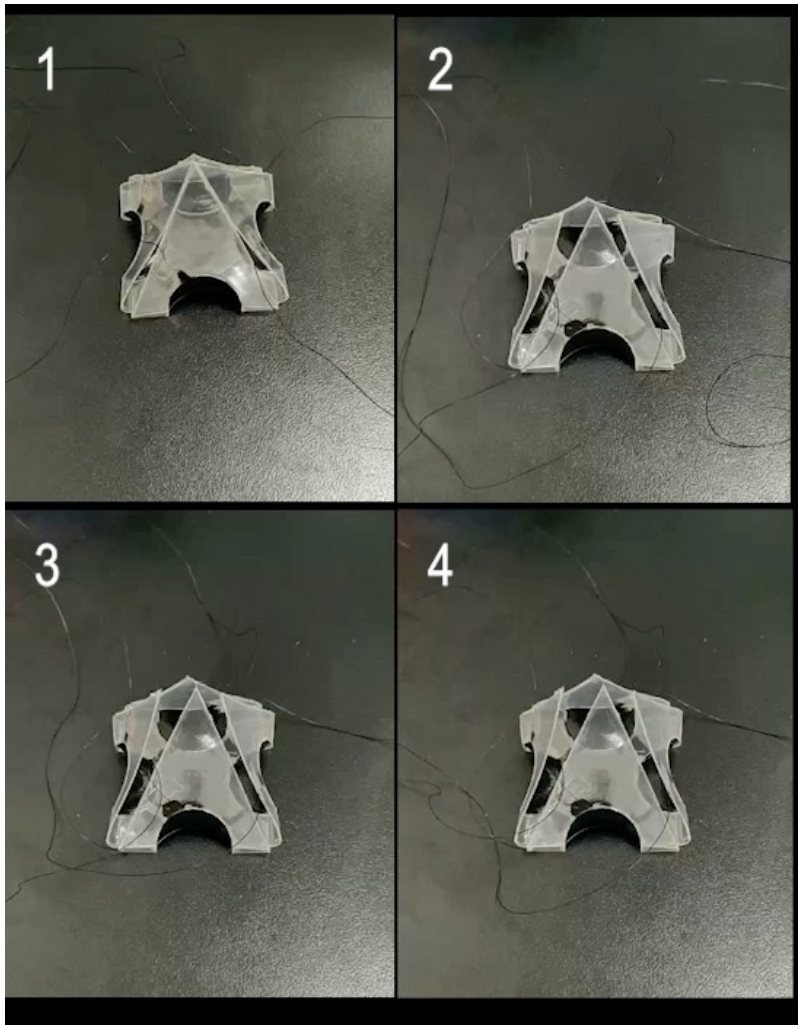




Tang et al. (2017)

Elastômeros Dielétricos - Atuadores

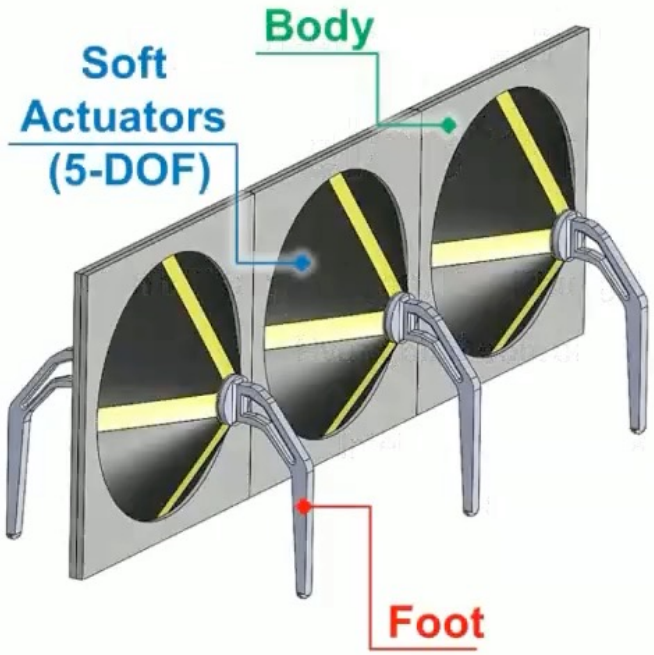


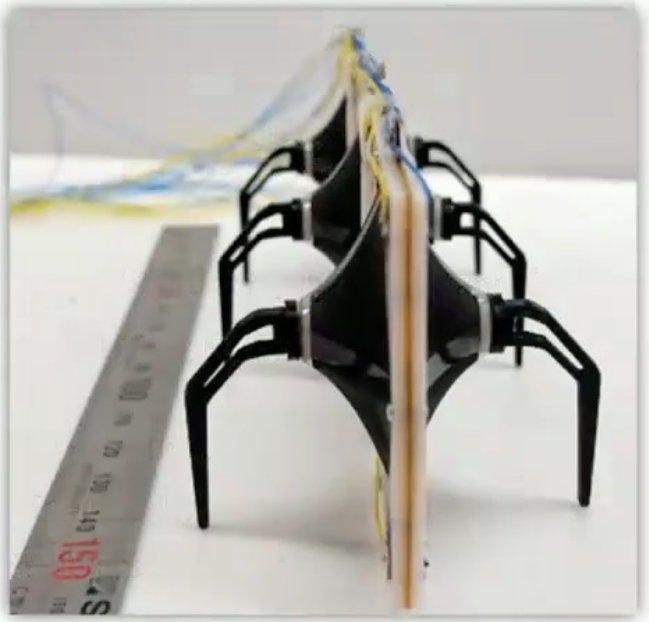


Tang et al. (2017)

Elastômeros Dielétricos - Atuadores

2nd Sungkyunkwan hexapod robot (S-Hex II)



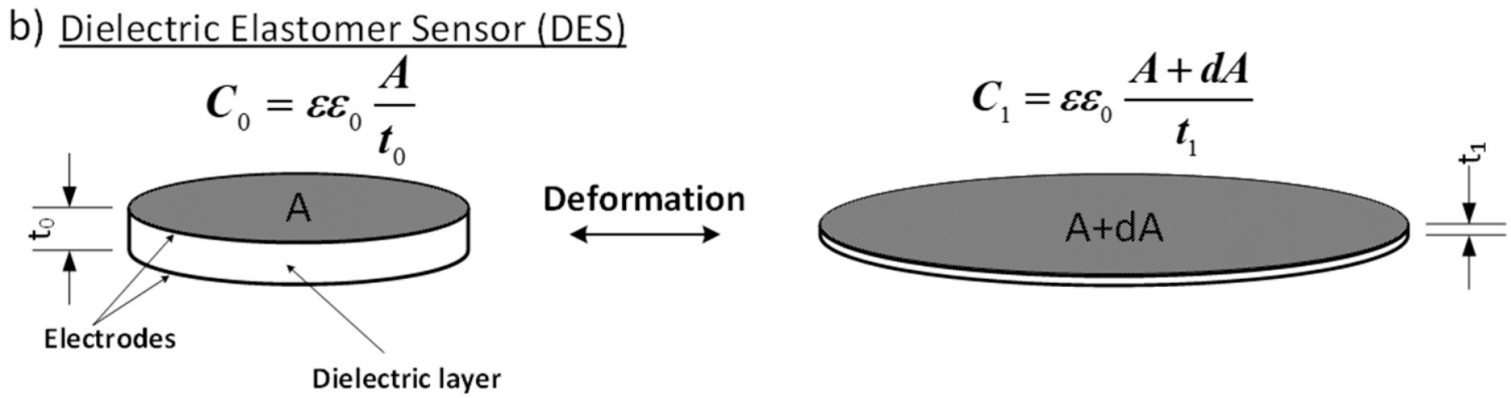


- Weight: 20 g
- 150 mm x 54 mm x 55 mm (L × W × H)

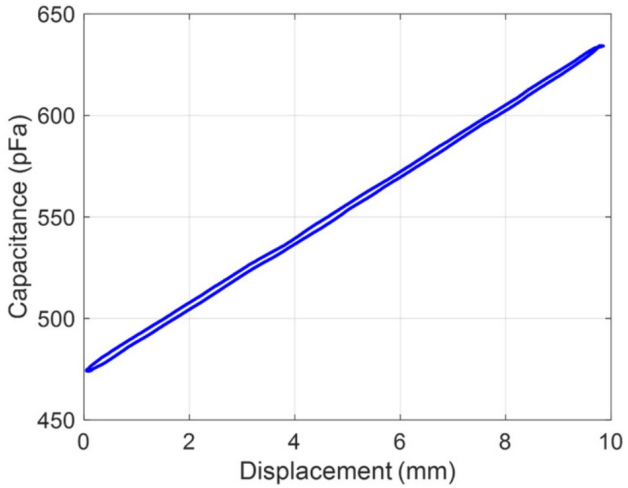
Overall design, mechanical components and prototype of the S-Hex II robot

Nguyen et al. (2017)

Elastômeros Dielétricos - Sensores

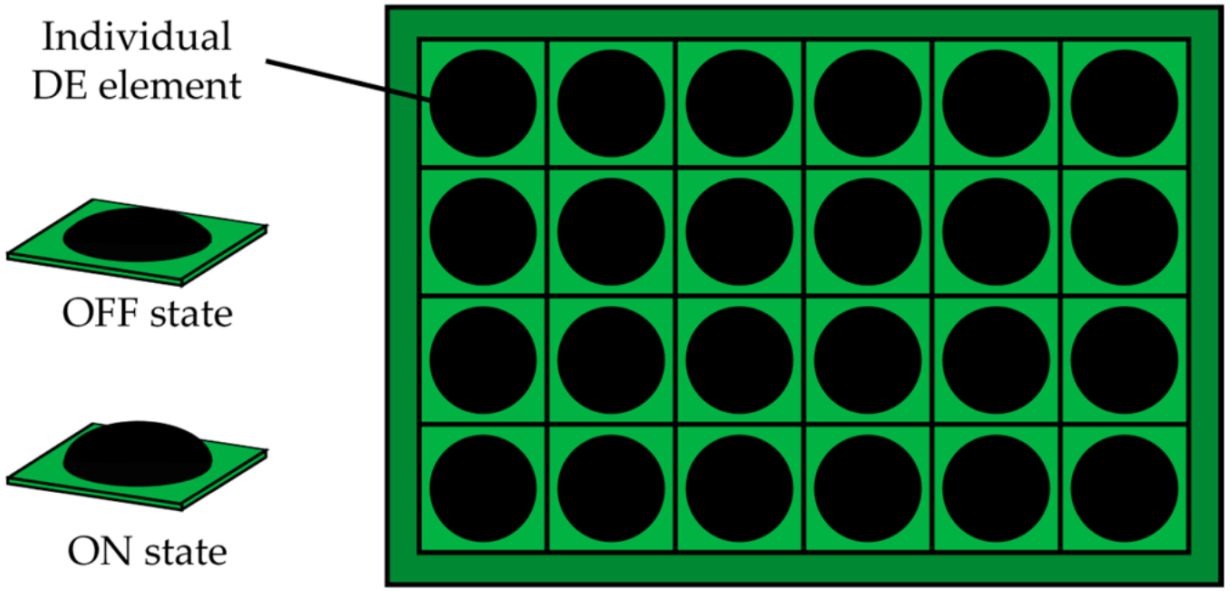


Cazacu et al. (2021)



Rizzello (2023)

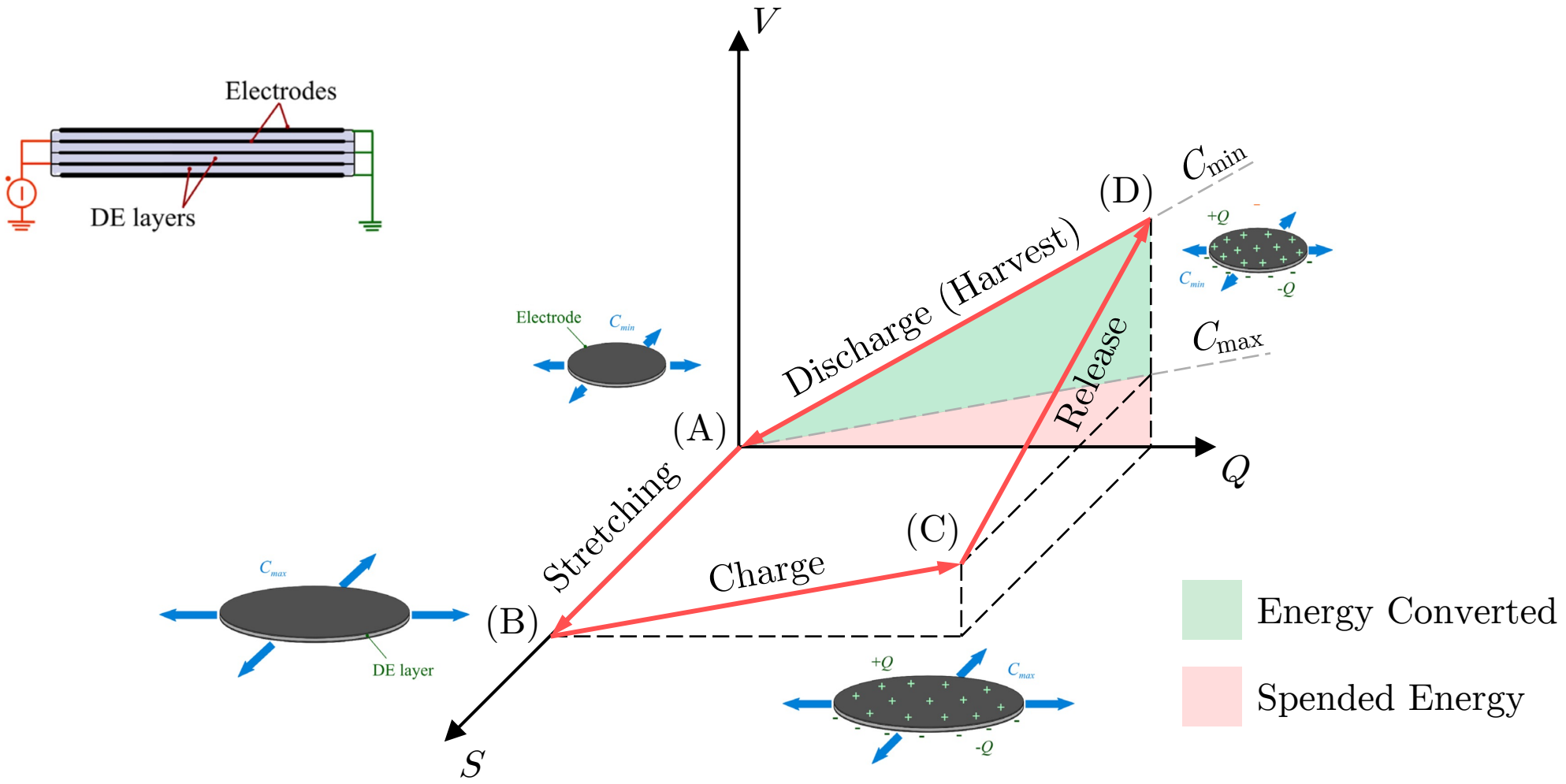
Elastômeros Dielétricos - Sensores



Rizzello (2023)

Böse & Ehrlich (2023)

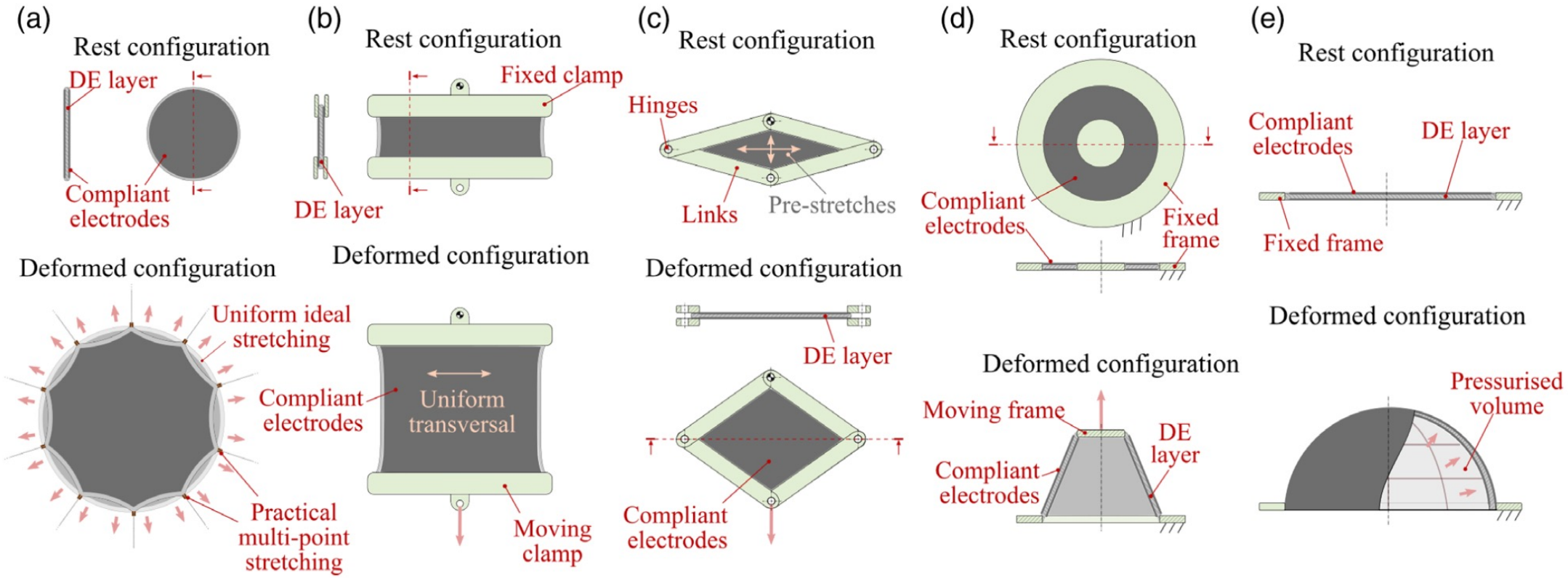
Elastômeros Dielétricos – Colheita de Energia (“Geradores”)



Elastômeros Dielétricos – Colheita de Energia (“Geradores”)

PolyWEC
polymeric wave energy converter

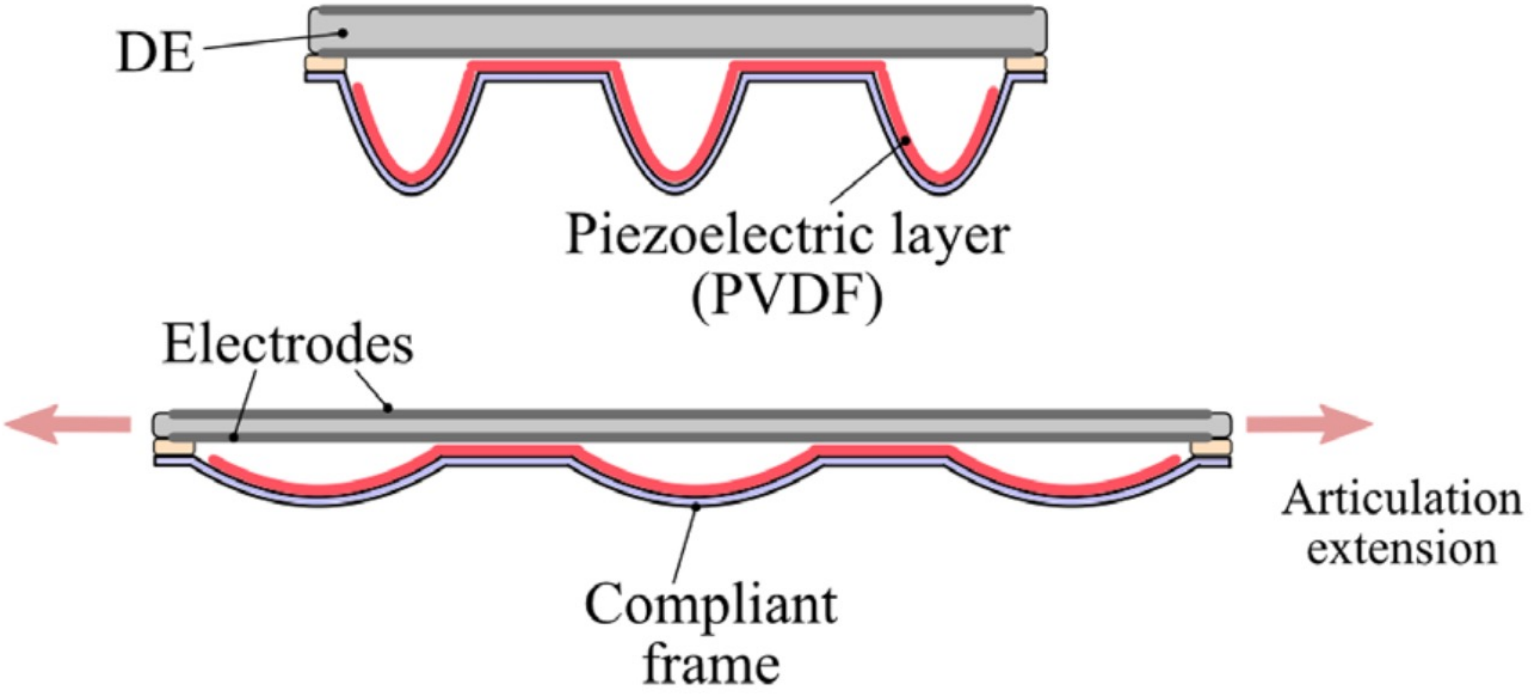
Elastômeros Dielétricos – Colheita de Energia (“Geradores”)

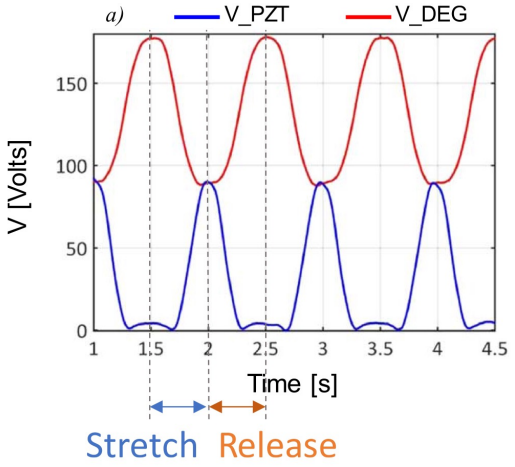


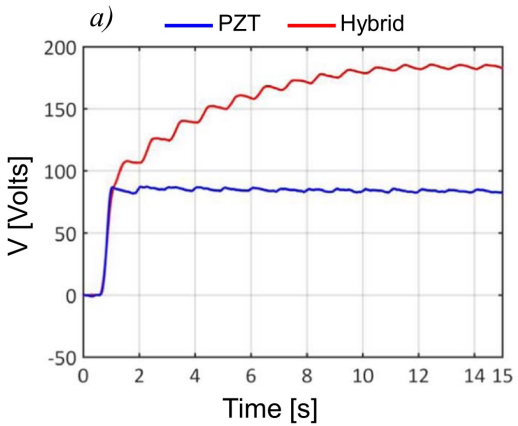
Mais Complexas e Menos Eficientes

Menos Complexas e Mais Eficientes

Elastômeros Dielétricos – Colheita de Energia (“Geradores”)

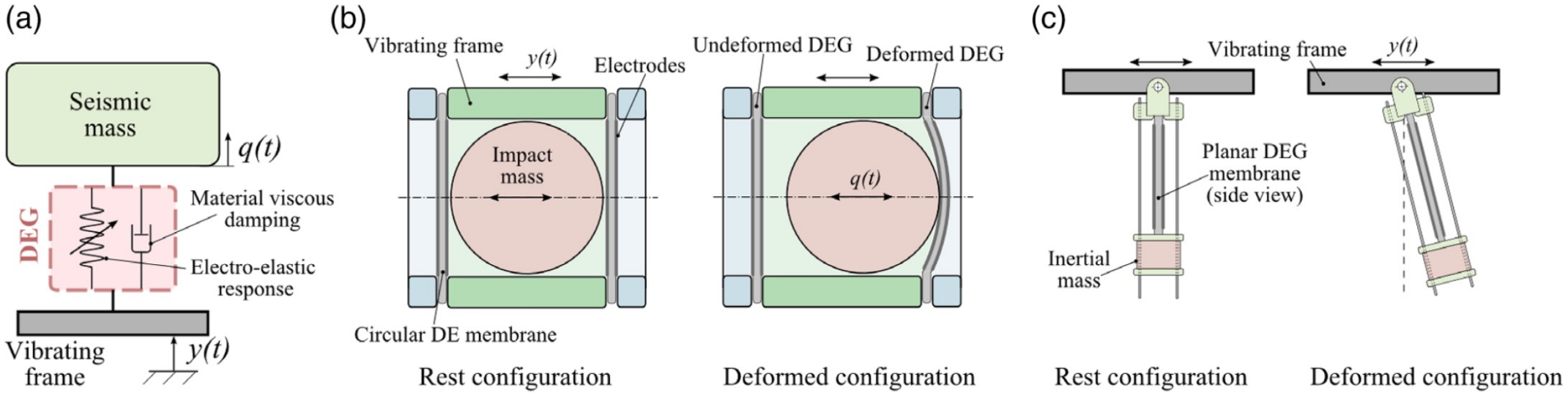






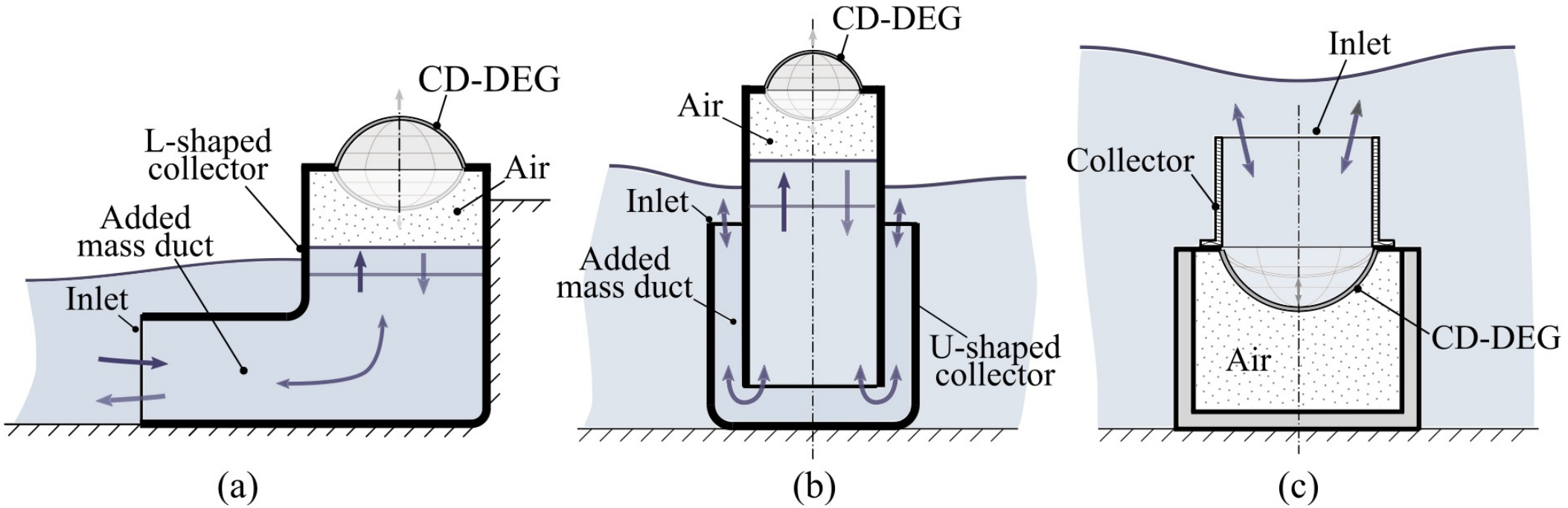
Moretti et al. (2020) | Lagomarsini et al. (2020)

Elastômeros Dielétricos – Colheita de Energia (“Geradores”)



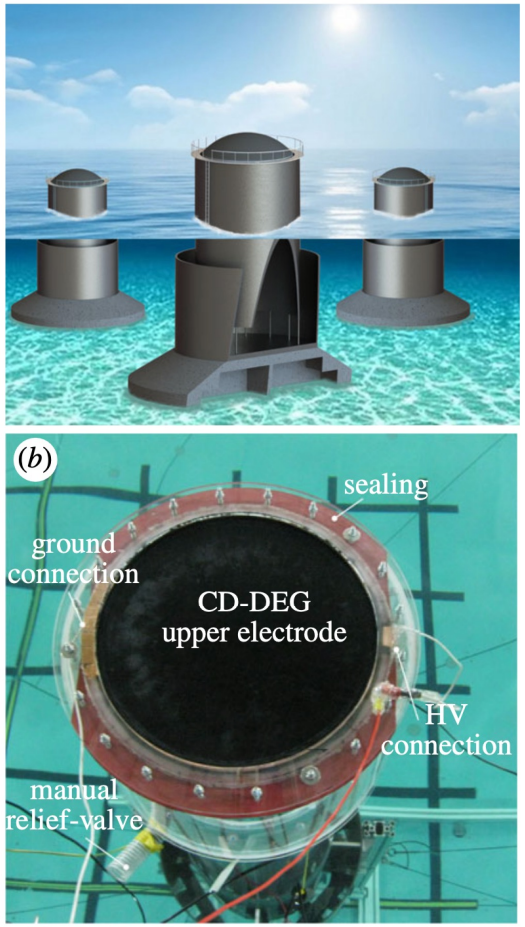
Moretti et al. (2020) | Tomson et al. (2019) | Fan et al. (2018)

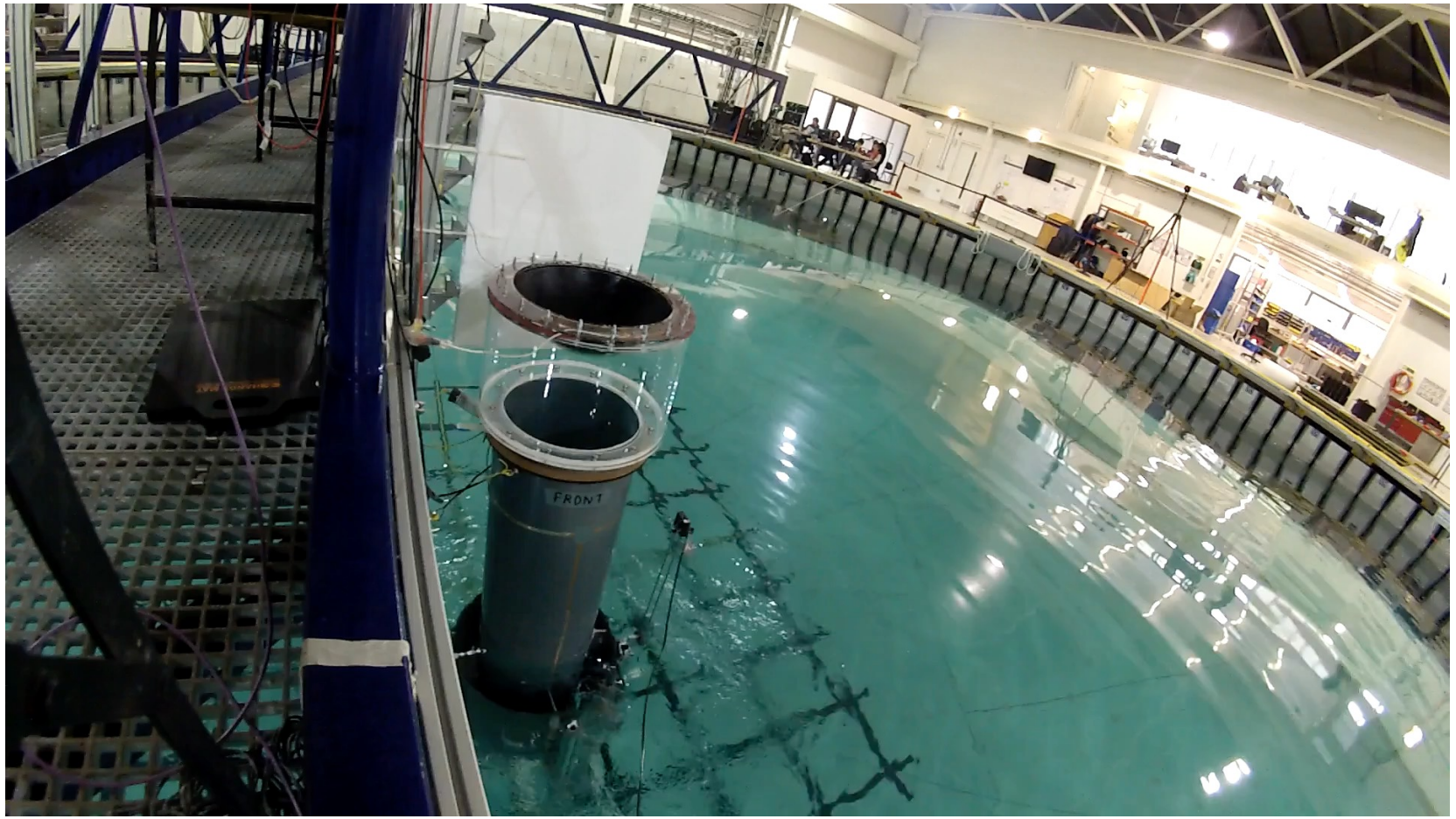
Elastômeros Dielétricos – Colheita de Energia (“Geradores”)



Moretti et al. (2019) | Moretti et al. (2020)

Elastômeros Dielétricos – Colheita de Energia (“Geradores”)





Moretti et al. (2019) | Moretti et al. (2020)

Elastômeros Dielétricos – Design Bioinspirado

Article

Controlled flight of a microrobot powered by soft artificial muscles

https://doi.org/10.1038/s41586-019-1737-7

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Published online: 4 November 2019

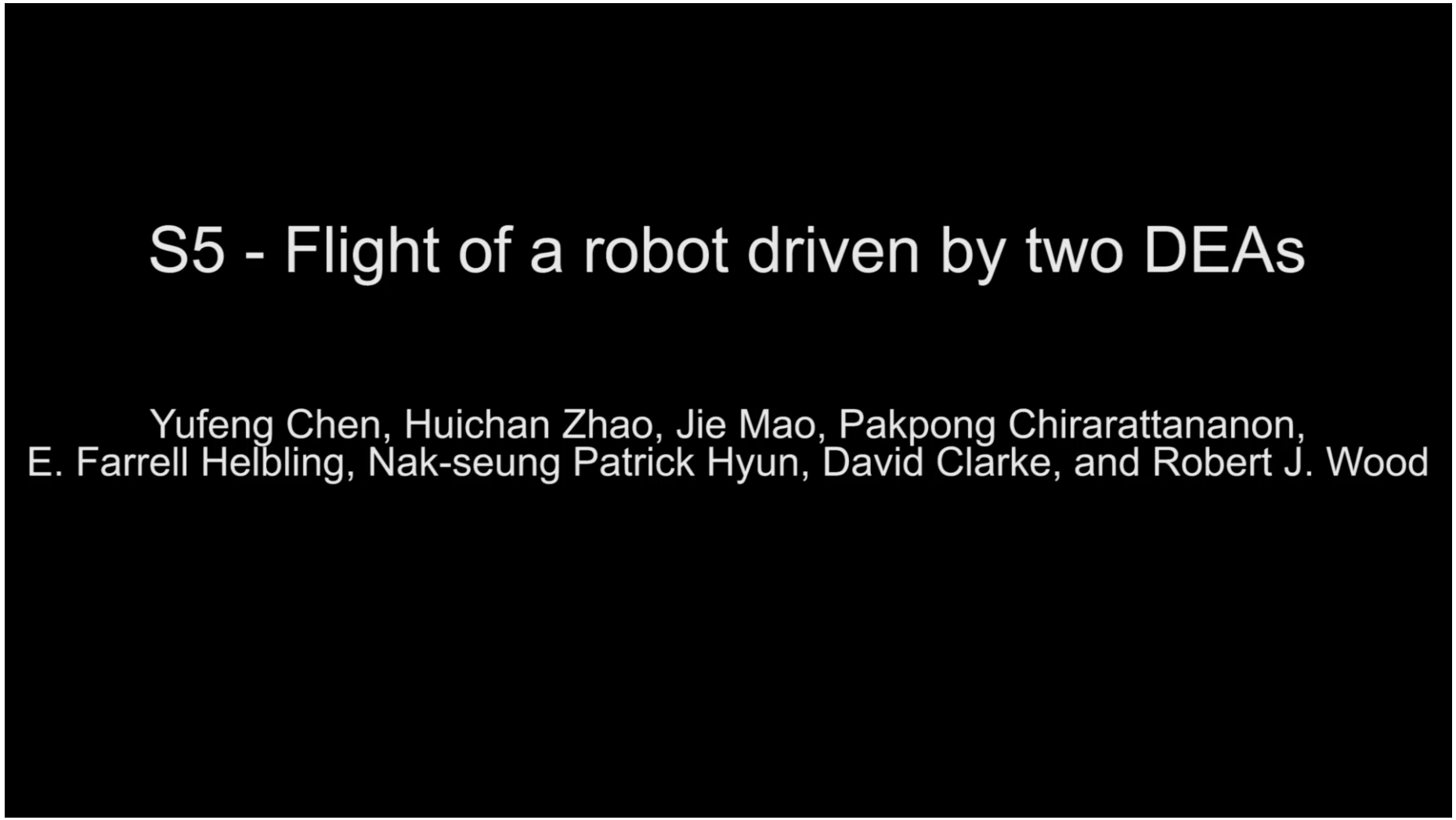
Yufeng Chen[1,2,3]*, Huichan Zhao[4], Jie Mao[1,5], Pakpong Chirarattananon[6], E. Farrell Helbling[1,2], Nak-seung Patrick Hyun[1,2], David R. Clarke[1] & Robert J. Wood[1,2]*

Flying insects capable of navigating in highly cluttered natural environments can withstand in-flight collisions because of the combination of their low inertia[1] and the

Elastômeros Dielétricos – Design Bioinspirado

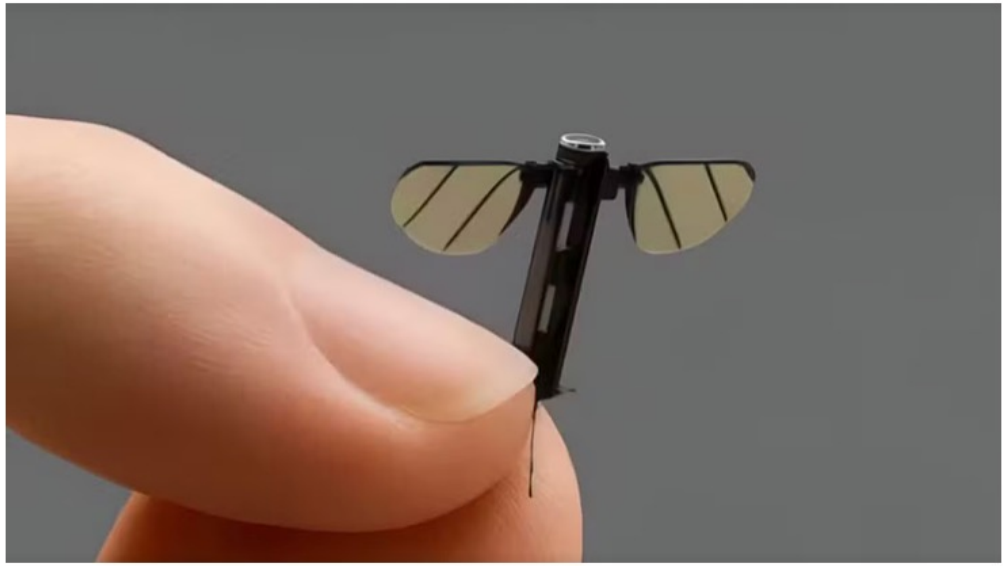
Chen et al. (2019)

Elastômeros Dielétricos – Design Bioinspirado



Chen et al. (2019)

Elastômeros Dielétricos – Design Bioinspirado



'Drone mosquito': conheça o 'nanoespião' da China capaz de atuar no campo de batalha

Pequim quer usar minúsculo espião em atividades de inteligência e combate. Minidrones potentes são cada vez mais requisitados no campo de batalha. Mas tecnologia ainda não é tão acessível assim.

Ontem — Em Mundo