The Webinar of AIDAA Educational Series and Academy, 22nd Feb, 2021

TUNEABLE DYNAMIC CHARACTERISTICS OF SOFT ELECTRO-ACTIVE (SEA) MATERIALS

Bin Wu (Marie Curie Fellow in NUIG)

School of Mathematics, Statistics and Applied Mathematics, NUI Galway
E-mail: BIN.WU@nuigalway.ie
Website: wubinlongchang.weebly.com

Collaborators: W.Q. Chen, E. Carrera, M. Destrade, C.Z. Zhang, ……

MARIE CURIE ACTIONS

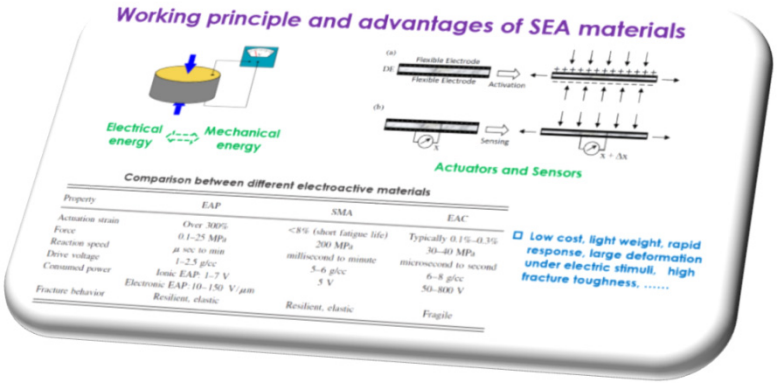
IRISH RESEARCH COUNCIL
An Chomhairle um Thaighde in Éirinn

HORIZON 2020

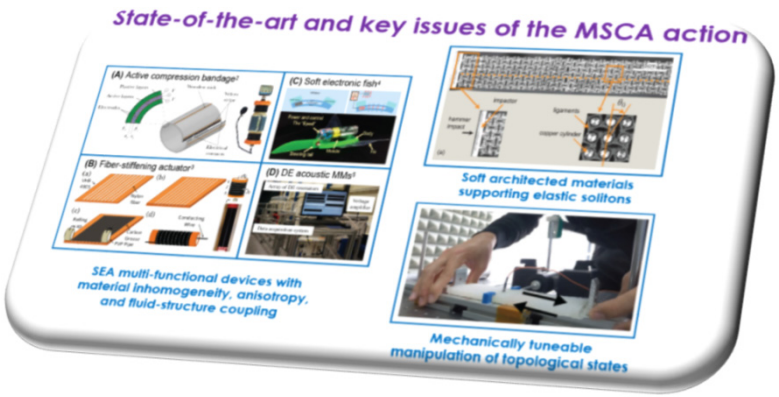
NUI Galway
OÉ Gaillimh

AIDAA
ASSOCIAZIONE ITALIANA
DI AERONAUTICA E ASTRONAUTICA

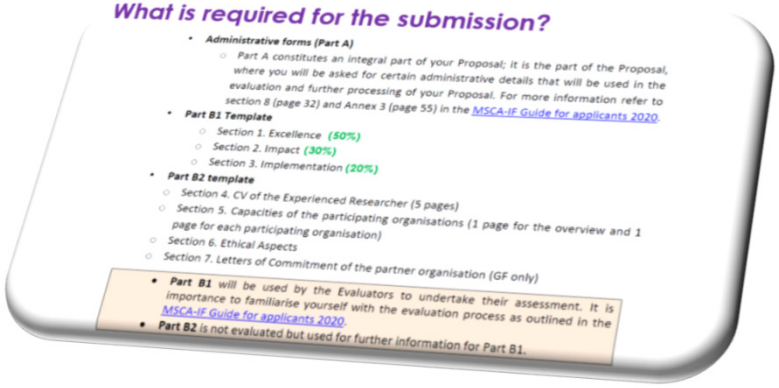
Research Background



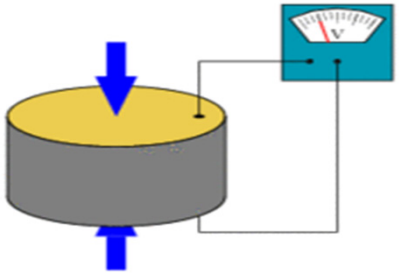
Key Issues and Objectives



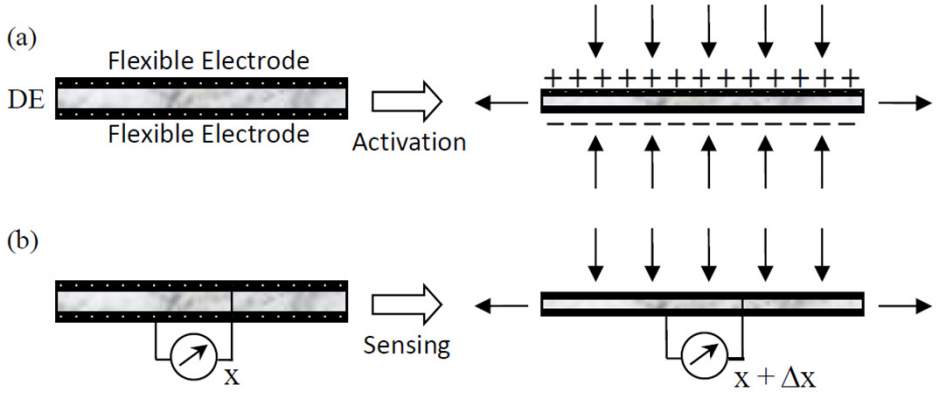
Lessons learnt from the MSCA Action



Working principle and advantages of SEA materials



Electrical energy ⇄ Mechanical energy



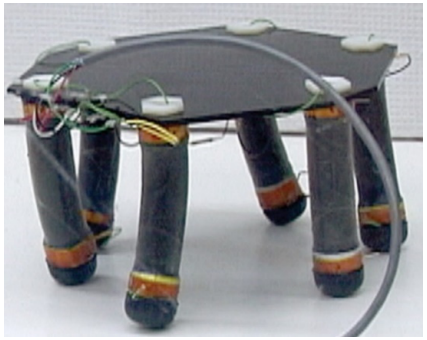
Actuators and Sensors

Comparison between different electroactive materials

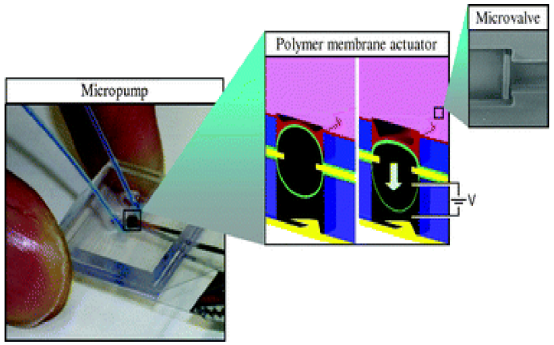
Property	EAP	SMA	EAC
Actuation strain	Over 300%	<8% (short fatigue life)	Typically 0.1%–0.3%
Force	0.1–25 MPa	200 MPa	30–40 MPa
Reaction speed	μ sec to min	millisecond to minute	microsecond to second
Drive voltage	1–2.5 g/cc	5–6 g/cc	6–8 g/cc
Consumed power	Ionic EAP: 1–7 V Electronic EAP: 10–150 V/μm	5 V	50–800 V
Fracture behavior	Resilient, elastic	Resilient, elastic	Fragile

- Low cost, light weight, rapid response, large deformation under electric stimuli, high fracture toughness, ……

Practical applications of SEA intelligent materials



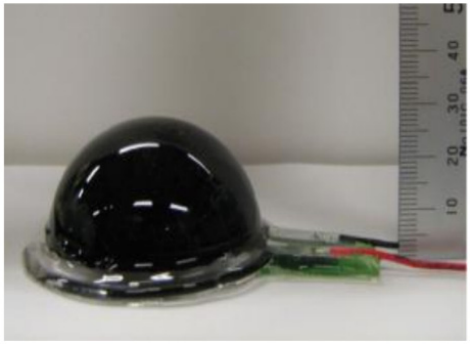
Spring roll walking robot



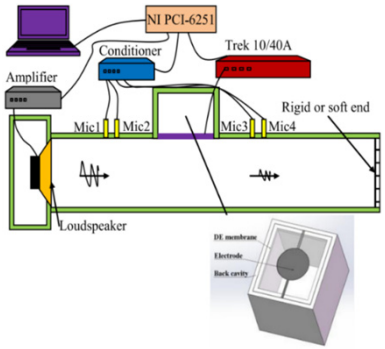
Micro-pump



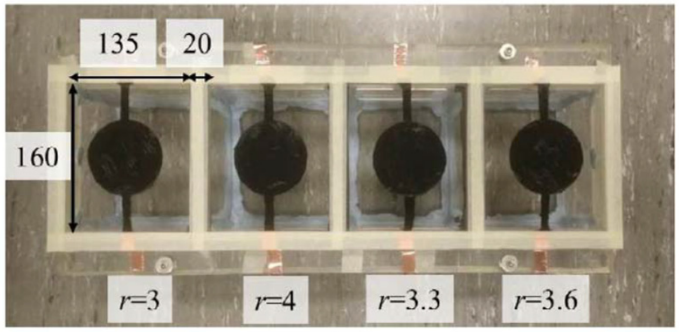
Energy harvester



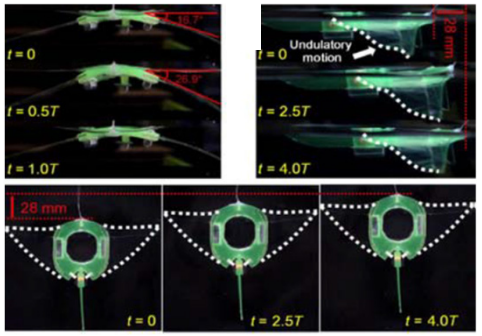
Semispherical speaker



Tuneable silencer



Tuneable acoustic metamaterials



Soft electronic fish

Biasing fields and examples

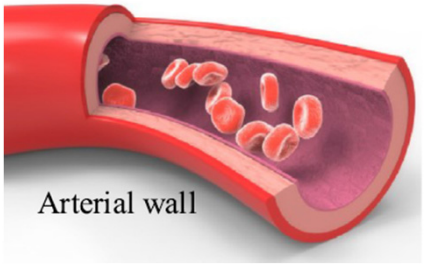
- **Biasing fields: Uniform or non-uniform fields** induced **in advance** by environmental factors such as mechanical, electric, magnetic, temperature, chemical fields, etc.
- **Negative effect: Instability or even damage and cracks in structures**

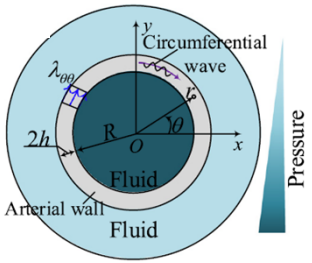


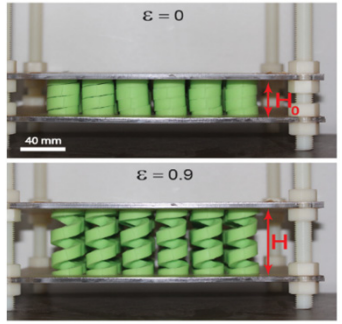




- **Positive effect: Modulate and improve the performance of technique and devices**

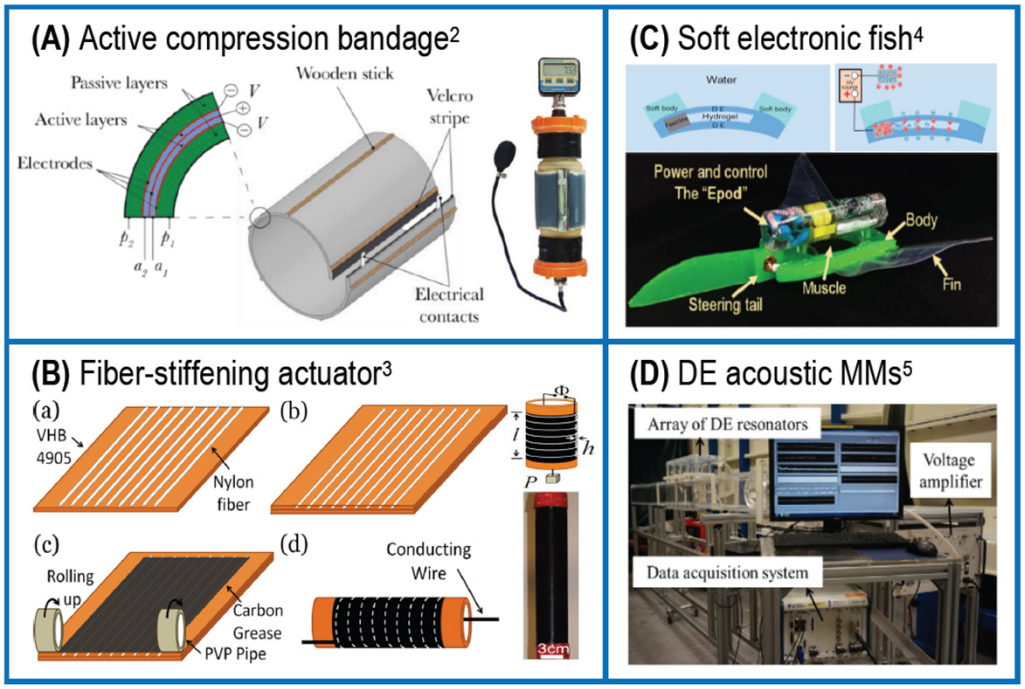





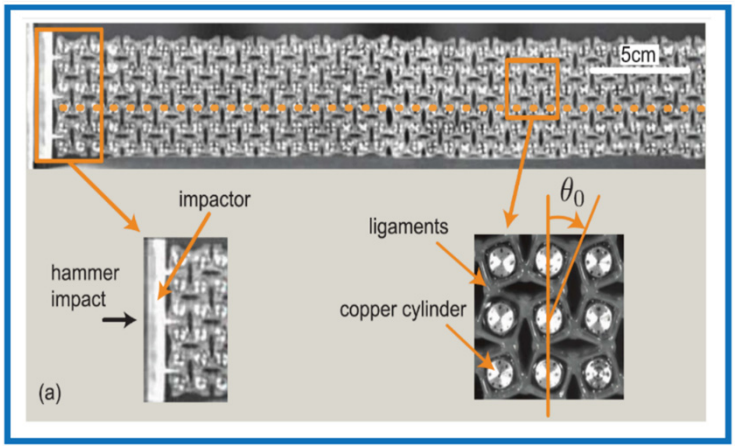


- Dorfmann L, Ogden RW (2014) Nonlinear Theory of Electroelastic and Magnetoelastic Interactions. New York: Springer.

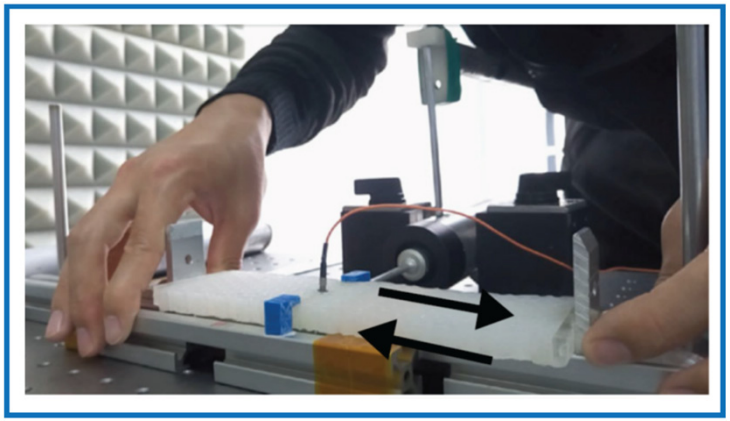
State-of-the-art and key issues of the MSCA action



SEA multi-functional devices with material inhomogeneity, anisotropy, and fluid-structure coupling

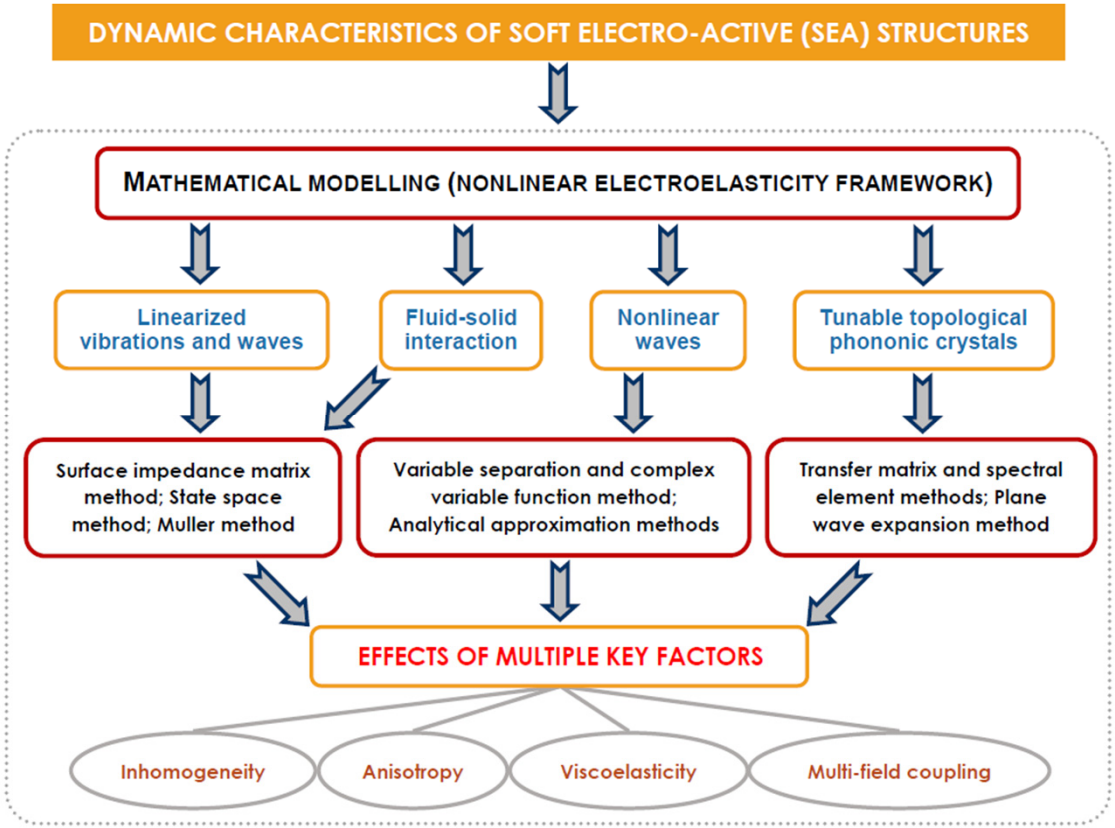


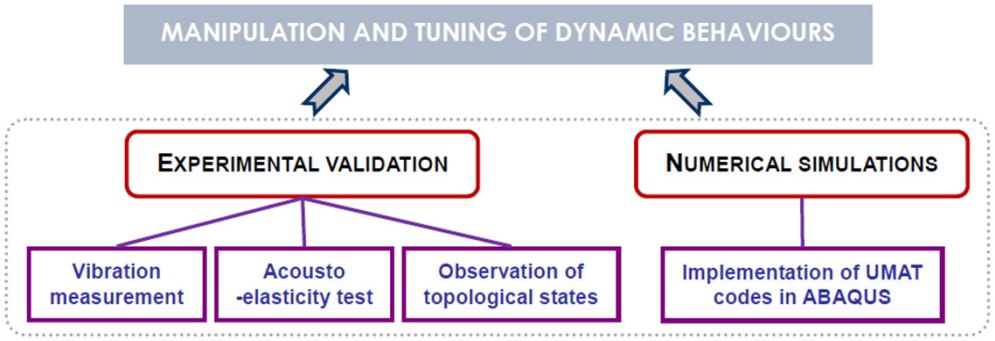
Soft architected materials supporting elastic solitons



Mechanically tuneable manipulation of topological states

Research programme and technical route





Mission statement:

- Key factors (inhomogeneity, anisotropy, viscoelasticity, fluid-solid interaction, periodic structures)
- New theoretical modelling with experimental tests and computer simulation tools.
- Promising applications, in ultrasonic nondestructive testing, ultrasound elastography, and design of actuators, tuneable resonators, and smart soft wave devices.

What is required for the submission?

- **Administrative forms (Part A)**
  - Part A constitutes an integral part of your Proposal; it is the part of the Proposal, where you will be asked for certain administrative details that will be used in the evaluation and further processing of your Proposal. For more information refer to section 8 (page 32) and Annex 3 (page 55) in the MSCA-IF Guide for applicants 2020.
- **Part B1 Template**
  - Section 1. Excellence **(50%)**
  - Section 2. Impact **(30%)**
  - Section 3. Implementation **(20%)**
- **Part B2 template**
  - Section 4. CV of the Experienced Researcher (5 pages)
  - Section 5. Capacities of the participating organisations (1 page for the overview and 1 page for each participating organisation)
  - Section 6. Ethical Aspects
  - Section 7. Letters of Commitment of the partner organisation (GF only)

- **Part B1** will be used by the Evaluators to undertake their assessment. It is importance to familiarise yourself with the evaluation process as outlined in the MSCA-IF Guide for applicants 2020.
- **Part B2** is not evaluated but used for further information for Part B1.

Part B1 of MSCA Action - proposal writing (1)

- Section 1. Excellence **(50%)**
- Section 2. Impact **(30%)**
- Section 3. Implementation **(20%)**

Criterion 1 – Excellence (50%)

- Quality and credibility of the research project; level of novelty, appropriate consideration of interdisciplinary and gender aspects
- Quality and appropriateness of the training and of the two-way transfer of knowledge between the researcher and the host
- Quality of the supervision and of the integration in the team/institution
- Potential of the researcher to reach or re-enforce professional maturity/independence during the fellowship

Part B1 of MSCA Action - proposal writing (2)

Criterion 2 – Impact (30%)

- ✓ Enhancing the future career prospects of the researcher after the fellowship
- ✓ Quality of the proposed measures to exploit and disseminate the project results
- ✓ Quality of the proposed measures to communicate the project to different target audiences

Criterion 3 – Implementation (20%)

- ➢ Coherence and effectiveness of the work plan, including appropriateness of the allocation of tasks and resources
- ➢ Appropriateness of the management structure and procedures, including risk management
- ➢ Appropriateness of the institutional environment (infrastructure)

Part B2 of MSCA Action - preparation of CV (1)

Section 1 – Provide details according to the following headings (2 pages):

- Personal Information
- Mobility & Career Objective
- Education & Professional Employment
- Teaching & Supervision Activities
- Funded Research Projects
- Institutional Responsibilities & Memberships Of Scientific Societies
- Commissions of Trust (Organization Of International Conferences; Invited Contributions; Reviewer For Journals)
- Major International Collaborations

Part B2 of MSCA Action - preparation of CV (2)

Section 2 – Early Achievements Track-Record (3 pages):

- Scientific Skills
- Research Impact
- Selected Honors & Awards
- Publications & Research Highlights
- Conference Proceedings
- Invited Presentations & Conference Talks
- Granted Patents
- Contributions to Industrial Innovation

MSCA-IF-2019 Action:
Proposal Acronym: DYN-SEAM
Grant Number: 896229

Thanks for your attention!

Any question?

Collaborators: W.Q. Chen, E. Carrera, M. Destrade, C.Z. Zhang, ……



School of Mathematics, Statistics and Applied Mathematics,
NUI Galway, University Rd, Galway
Email: bin.wu@nuigalway.ie
Website: wubinlongchang.weebly.com