

Machine Learning for Adaptive Behavior in Smart Soft Materials

Friday, 12 December 2025 14:30 (15 minutes)

We are developing a new class of soft, adaptive composite materials with tunable stiffness and embedded electromechanical responses. Under controlled mechanical activation, these materials generate complex multimodal signals that are strongly coupled to their internal structure.

Before any robotic finger or human testing, our primary focus is AI for Materials: using machine learning to understand, map, and predict the behaviour of nonlinear soft composites. Building on multiscale characterisation data (electron microscopy and in-situ/mechanical testing), we aim to explore modelling approaches capable of:

- identifying optimal and smooth modulus gradients,
- analysing particle distribution and agglomeration patterns,
- learning structure–property–response relations under different activation states,
- detecting emergent nonlinear behaviour in adaptive composites.

While the core of this work is material-centred, the resulting models may also support downstream AI-assisted control or interpretation frameworks in soft robotic applications.

We welcome collaboration from researchers working on:

- physics-informed ML,
- data-efficient modelling,
- multimodal data fusion,
- AI for materials and adaptive systems.

Author: Dr KANDEMIR, Ayse Cagil (TED University)

Presenter: Dr KANDEMIR, Ayse Cagil (TED University)