Soft Robotics & AI — Updated 15 Minute Script for Two Speakers

Slide 1 — Title (30s)

Speaker 1:

Hello everyone, welcome to our presentation on Soft Robotics and AI.

I'm Yijiao Qin, and this is Dongyang Zhu. Today, we'll share how bio-inspired robotics, especially soft robotics, combine with AI to create adaptive, intelligent systems.

Slide 2 — Motivation (1.5 min)

Speaker 2:

Rigid robots are precise and strong, but brittle in unstructured environments.

Think about trying to pick up an egg with a rigid gripper — it will break.

Nature solves this with soft, deformable bodies. Octopuses, elephant trunks, and starfish can grip, bend, and adapt to their environments with ease.

AI enables control of these complex, hard-to-model systems, helping soft robots succeed where rigid ones fail.

Slide 3 — What is Soft Robotics? (1.5 min)

Speaker 1:

Soft robotics uses compliant materials like silicones, elastomers, and textiles.

They are deformable, safe for interaction with humans, and adaptive in unpredictable settings.

A key advantage is morphological computation: the body itself helps solve problems.

For example, a compliant gripper conforms naturally to an object without needing precise control.

This makes soft robots ideal for healthcare, agriculture, and underwater exploration.

Slide 4 — Why AI is Needed (1.5 min)

Speaker 2:

Soft bodies are difficult to model — their motion is nonlinear and complex. Traditional PID control struggles.

Reinforcement Learning (RL) lets robots learn by trial and error.

Evolutionary algorithms can optimize both the body and controller.

Differentiable simulation allows training end-to-end, with gradients through physics models.

Together, these AI approaches unlock the potential of soft robotics.

Slide 5 — Case Study: Evolution Gym (2.5 min)

Speaker 1:

Let’s look at Evolution Gym, a platform for studying soft robots and AI.

Robots are built from voxels — small blocks that can be rigid, soft, or actuators.

Different voxel layouts create different morphologies.

Environments test the robots in tasks like Walker, Climber, and Pusher. Each has rewards, like distance traveled or climbing height.

The training process:

- AI policy controls actuators.

- Learns via reinforcement learning through trial and error.

- Rewards improve as robots discover gaits.

Outputs:

- robot.npz: the body morphology.

- ppo_evogym_walker.zip: the learned policy, the robot’s “brain.”

Result: robots evolve gaits for walking, climbing, pushing — AI discovers how to move.

Slide 6 — Demo (1.5 min)

Speaker 2:

We’ll run a small demo.

- First, train with train_evogym_save.py to produce the robot and brain files.

- Then, play with play_evogym_saved.py to see the robot move in the simulator.

This highlights how AI can turn a pile of voxels into a robot that learns to move forward.

Slide 7 — Results (1 min)

Speaker 1:

Reinforcement learning allows robots to control their morphology.

They can adapt to grasping, pushing, and locomotion.

This demonstrates emergent intelligence from co-design of body and brain.

Slide 8 — Challenges (1 min)

Speaker 2:

Challenges remain.

- Sim-to-real gap: policies may not transfer perfectly from simulation.

- Material fatigue: soft materials wear out.

- RL training: can be long and computationally expensive.

Slide 9 — Future Directions (2 min)

Speaker 1:

Future work includes:

- Differentiable soft-body physics for faster training.

- AI co-designing bodies and controllers together.

- Medical applications, like soft surgical robots.

- Environmental robots, such as soft underwater swimmers.

Slide 10 — Conclusion (1 min)

Speaker 2:

To conclude: soft robotics are safe, adaptive, and bio-inspired.

Speaker 1:

And AI unlocks their potential by learning complex control. Together, they create robots that move and adapt like nature.

Both:

Thank you for listening. We’d be happy to take questions.

Timing Breakdown:

- Intro + Motivation: 2 min

- Soft Robotics + Why AI: 3 min

- Case Study + Demo: 4 min

- Results + Challenges: 2 min

- Future + Conclusion: 3–4 min

Total: ~15 min