



# SHANGHAI LECTURES

UNIVERSIDAD CARLOS III DE MADRID

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# ¿Qué son las ShanghAI Lectures?

- Embodied Intelligence
  - Inteligencia como interacción con el entorno
  - Inteligencia es una propiedad de un organismo entero
  - Robótica, Inteligencia Artificial y Ciencias Cognitivas
- Enseñanza global



# Objetivos

- Conocimiento puntero accesible a todo el mundo
- Nuevos métodos de transferencia del conocimiento
- Aprendizaje en entornos multiculturales e interdisciplinarios
- Fomentar el pensamiento crítico

# Historia

- Desde 2009
- >50 universidades
- UC3M:
  - Curso optativo dentro del Máster de Robótica y Automática
  - Abierto al resto de la comunidad UC3M



# Organización

Sesiones + Kōans



# Estructura de la sesión

1. Charla principal (30 ~ 50 min)
2. Charla invitada (1 ~ 3 por sesión)
3. Participación de los alumnos
  - Mini presentaciones desde alguna sede

# Charlas principales

- Artificial Intelligence: things can be seen differently.
- A Theory of Embodied Intelligence.
- Intelligent Systems: Properties and Principles
- Evolution: Cognition from Scratch
- Developmental Robotics: Language.
- Collective Intelligence: Cognition from Interaction
- Morphological Computation, Self-Organization of Behaviors and Adaptive Morphologies.
- Industry day/Ethics-Societal-Economy
- Future Trends: Grab Bag, Summary, Discussion



# Charlas invitadas

- *Ruairi Glynn, University College London, United Kingdom. Understanding the Behaviour and Interaction of Things, Environments and their Inhabitants.*
- *Martin F. Stoelen, University of Plymouth, United Kingdom, i. The 2015 Kōans.*
- *Olivier Michel, Cyberbotics Ltd., Switzerland. The NAO race!*
- *Fumiya Iida, ETH Zürich, Switzerland. Challenges and perspectives on morphology changing robots.*
- *Florian Röhrbein, Technische Universität München, Germany. Robotics in the Human Brain Project.*
- *Angel P Del Pobil, Jaume I University, Spain. The Visual Neuroscience of Robotic Grasping.*
- *Antonio Chella, University of Palermo, Italy. Machine consciousness.*
- *Christopher Lueg, University of Tasmania, Australia. Embodiment - implications for studying (human) information behavior.*
- *Helmut Hauser, University of Bristol, United Kingdom. Morphosis – The Next Level in Morphological Computation.*
- *Alexander Schmitz, Waseda University, Japan. Softness and compliance in human-symbiotic robots.*
- *Sabine Hauert, University of Bristol, United Kingdom. Swarming nanosystems for biomedical applications.*
- *Nicola Vitiello, Scuola Superiore Sant'Anna, Italy. IUVO*
- *Josh Bongard, University of Vermont. Evolving robots to study adaptive behavior.*
- *Andrea Bertolini, Scuola Superiore Sant'Anna, Italy. The Robolaw project legacy.*



# Kōans

- Equipos internacionales
- 2 tutores
- Webots / Robots
- Presentación

## Kōan 2: From passive to actuated dynamic walking

Do you have other ideas?  
Feel free to be creative!

- A passive dynamic walker exploits its own intrinsic dynamics to generate a "natural" and energy-efficient gait, but with several limitations:
  - It typically requires a downward slope for adding energy
  - It is typically limited to a very even and obstacle-free surface
- Could you add actuators? Where?
- What about sensors on the sole of the feet? Reflexes?
- How could you change the speed? (hint: check recommended reading)
- Students could start by exploring the "Webots passive walker example"
- What potential applications exist for very energy-efficient walking?

65 km on one charge - the Corwell Ranger



P. Shoup, et al., Low bandwidth reflex based control for human powered walking: 65 km on a single battery charge. *International Journal of Robotics Research*, vol. 23, no. 12, pp. 1350-1370, 2004. DOI: 10.1177/0278014404267045. <https://doi.org/10.1177/0278014404267045>

\*<https://github.com/robotics-experiments/2022>

## Kōan 7: Wearable soft robotics

- Soft robotics provides tools for making safe and comfortable wearable devices ranging from power-assist and rehabilitation to shape-changing clothing.
- Design a wearable soft device, and fabricate a prototype of it. Use your imagination.
- Good places to start for ideas:
  - [Soft Robotics Toolkit\\*](#)
  - [PneuFlex Tutorial\\*\\*](#)
  - [JamSheets\\*\\*\\*](#)
- How is the soft mechanism coupled with the human body? How is this related to the lecture topics?



Henry Pfeiffer with self-adjusting jacket. *Back to the Future Part II*

Do you have other ideas?  
Feel free to be creative!

<https://github.com/robotics-experiments/2022>  
<https://www.robotics-experiments.org/2022/pneuflex-tutorial>  
<https://www.robotics-experiments.org/2022/jamsheets>

## Kōan 3: Take Puppy out for a walk

- We have seen that Puppy can move in a "natural" way with very simple actuation (e.g. one servo in each leg) and passive compliance (springs)
- But how well does the gait work in complex uneven terrains, and what factors contribute to the success/failure of the locomotion?
- The students can start from the Puppy example<sup>1</sup>, and put it in an uneven terrain. Explore performance and investigate improvements. Reflexes?



Checkout demoPuppy:  
<https://www.youtube.com/watch?v=8m8m8m8m8m>



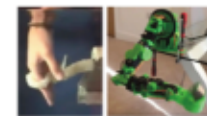
Do you have other ideas?  
Feel free to be creative!

## Kōan 1: Soft catch

- Reliably catching objects is hard, but progress is being made (see videos)
- Can a "soft" embodiment simplify the problem? If so, how?
- One source of inspiration could be the human body - what is the key to a successful catch?
- How does a passively compliant structure increase the time available to close the hand? How/why is the control simplified? Is it?
- Can a "soft" embodiment also simplify the needed sensing?
- See for example the GummiArm<sup>1</sup>



Robot catches a variety of objects (w/ globally tracked marker): <https://youtu.be/8K1L3L3L3L>



Soft octopus arm: <https://youtu.be/8K1L3L3L3L>  
Passive "catch": <https://youtu.be/8K1L3L3L3L>

Do you have other ideas?  
Feel free to be creative!

\*<https://github.com/robotics-experiments/2022>

# Infraestructura

- Adobe Connect




- Streaming



- Website: <http://shanghailectures.org>



# Resultados

- Estudiantes
  - 44 siguieron la evaluación
  - 8 Kohans realizados
  - <https://github.com/Butakus/shai-collab/wiki>
- Opiniones de los estudiantes
  - Colaboración internacional
  - Trabajar en inglés
- Redes sociales    

# Lecciones aprendidas

- Tecnología mejorable
- Interés por lo que no está en los libros
- Mucho más que ingenieros
- Interacción con/entre investigadores



GRACIAS

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