JOINT ROBOTDOC/ POETICON++ - SPRING SCHOOL ON DEVELOPMENTAL ROBOTICS AND COGNITIVE BOOTSTRAPPING

Amalia Hotel, Athens,18-20 March, 2013

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PROGRAMME

Venue: *Amalia Hotel,* 10 Amalias Ave, Athens

Monday March 18

12:00 arrival

13:00 Iannis Tsoukalas (European Parliament, Greece MEP)

14:00 Reinhard Lafrenz (Technical University Munich, ECHORD Project Manager)

15:00 Jean-Christophe Baillie (Aldebaran Robotics)

16:00 coffee break

16:30 Vincent C. Müller (Anatolia College & Oxford University, EuCogIII Coordinator)

17:30 Denis Mareschal (Birkbeck College London, TrackDev ITN)

18:30 Jannik Fritsch (HONDA Research Institute Europe)

20: 00 Dinner at Kuzina Restaurant (directions attached)

Tuesday March 19

9:00 Katerina Pastra (CSRI and ATHENA Research Centre; Poeticon++ Coordinator)

10:00 Yiannis Aloimonos (University of Maryland, USA)

11:00 Poster Session 1 and coffee break

12:00 Luciano Fadiga (Italian Institute of Technology and Ferrara University)

13:00 Kevin O'Regan (Descartes University Paris and CRNS France)

14:00 Lunch

15:00 Marco Zorzi (Padua University). Deep learning of visual numerosity

16:00 Matt Schlesinger (Southern Illinois University, USA)

17:00 Poster Session 2 and coffee break

20:00 Dinner at the Strofi Tavern (directions attached)

Wednesday March 20 - Tutorials

9:00 *Tutorial 1: Towards a Semantic Memory for Robots*
Eirini Balta and Panagiotis Dimitrakis (CSRI)

11:00 coffee break

11:30 *Tutorial 2: Timing in Humans and Robots*
Argiro Vatakis (CSRI) and Michalis Maniadakis (ICS-FORTH)

13:30 Spring School ends

Day 1: March 18

ABSTRACTS OF TALKS

Iiannis Tsoukalas, European Parliament, Greece MEP

EU Research Policy and Robotics

This talk will discuss recent developments of the EU Research and Development agenda and plans for Horizon 2020, with a specific focus on robotics research.

Reinhard Lafrenz, Technical University Munich, DE

ECHORD and ECHORD++ - Innovative approaches to strengthen the links between academia and industry

In the past 4 years, the ECHORD project showed a new way of handling small-scale projects and to organise a "structured dialogue" to foster the cooperation and the knowledge transfer between academia and industry. The small-scale projects, so-called experiments, are carried out by consortia of 2-3 partners, ideally composed of academic and industrial partners. They perform actual research on a topic which can be categorised by two independent axes, scenarios and research foci. The "structured dialogue" is a combination of instruments to gain insight into the best practice of knowledge transfer with a special focus on small and medium-sized enterprises (SMEs) and start-ups.
In the talk, and overview of the ECHORD project, examples of successful experiments within, and main results from the structured dialogue will be given. Furthermore, the instruments added in the follow-up-project ECHORD++ (start autumn 2013) will be presented.

Jean-Christophe Baillie*,* Aldebaran Robotics, FR

Developmental Robotics at Aldebaran A-Lab

Aldebaran Robotics is launching a developmental robotics activity as part of the new A-Lab research entity. The scope of interest will range from low level categorization of sensorimotor information, up to high level lexical and grammatical language acquisition. I will shortly introduce the A-Lab and in particular the AI group with a rapid outlook on the research agenda and approach, stressing the potential for collaboration and the long term applicative view of the company.

Vincent C. Müller, Anatolia College & Oxford University

What is a cognitive system?

While there is a lot of talk about artificial 'cognitive systems', there is relatively little explanation of the term and little definite positions what would constitute making one. Traditionally, we distinguished cognition from volition and emotion (and left out perception and action entirely). Then we invented 'cognitive science' together with artificial intelligence (classical AI), which turned out to be too intellectual and computational, and now we try to develop 'intelligent systems' that are robust and flexible. In our view, a cognitive system is a system that learns and uses its knowledge and abilities flexibly to achieve its own goals. This allows it to deal with an uncertain world, as natural cognitive systems do - within their ecological niche. The room for artificial cognitive systems is large, since natural systems tend to be flexible but not very successful on specific tasks, while artificial systems tend to be inflexible, but successful on specific tasks - artificial cognitive systems can combine these virtues, be both flexible and successful on specific tasks.

Reading:

Gomila, Antoni and Müller, Vincent C. (2012), 'Challenges for artificial cognitive systems', Journal of Cognitive Science, 13 (4), 453-69.

***Denis Mareschal**, Birkbeck College London, TrackDev ITN, UK*

Mechanisms of learning and development in infancy

In this talk I will discuss the aims of computational modelling in developmental sciences and suggest that neural networks provide a fruitful framework for understanding the the mechanisms and processes involved in early learning. I will illustrate this with examples form the domain of speech segmentation, early concept learning and infant-object interactions. In addition, I will discuss and illustrate how computational models can and should lead to testable predictions.

Jannik Fritsch, HONDA Research Institute Europe, DE

Automotive Research at HRI-EU: Perception & Prediction Activities

The talk will cover selected research activities at the Honda Research Institute Europe (HRI-EU) that are targeted at driver assistance. The coarse functionality and processing of several functions that are currently being investigated will be outlined together with a view on the constraints that influence the ongoing research activities. The researched functionalities are:

- Road Terrain Analysis and Prediction
- Rear Approach Warning
- intelligent Adaptive Cruise Control (iACC)

DAY 2: March 19

ABSTRACTS OF TALKS

Katerina Pastra, Cognitive Systems Research Institute, Athens, GR

Robots with Syntax, Robots with Memory: Beyond one-shot learning to generalisation

Inclusion of language in the robot seeing-robot acting-robot learning loop, is a requirement for cognitive robotics that goes well beyond communication needs between humans and machines. A growing body of experimental research on how the human brain works, points to the possibility that language and the motor system have co-evolved because one was functional to another. In this talk, we will show how robots can be endowed with a single syntactic mechanism for both language and action analysis and generation. We argue that this skill is key for generalisation in cognitive robots, opening up new roads not only in language processing, visual and motoric action analysis and action generalisation, but also in knowledge representation and reasoning. We will show, how language can be parsed into denoted action-tree graphs, along the specifications of the first ever generative grammar of action, and how such analysis is the meeting point with corresponding visual scene parsing. The resulting action structures (in both their symbolic and sensorimotor manifestations) are core units of the first 'semantic-memory' like module for robots that we will demonstrate live.

Yiannis Aloimonos, Computer Vision Laboratory, University of Maryland, USA

Parsing human activity

Cognitive Robots that will co-exist with humans and assist them in a variety of tasks, will need to recognize complex human activity. Towards this goal, we recently introduced (with K. Pastra) a minimal grammar modeling human action. In this talk I present a preliminary parser that using the minimal grammar parses and recognizes human actions involving tools and objects. To achieve the construction of the parser we need a number of tools (processes) in the sensory motor domain, namely attention operators, object segmentation and goal detection. The talk will describe in detail the torque operator, a new low level visual operator that implements attention, visual filters that learn the appearance of objects, fixation-based segmentation that segments only objects towards which attention is focused and the recognition of the effects of action on objects (goals). Examples and demonstrations will be shown and I will point the audience to downloadable software that we developed for these tasks.

Luciano Fadiga, Ferrara University and Italian Institute of Technology, IT

Sensorimotor processing of language

Despite the fact that the famous 'motor theory of speech perception' by Alvin Liberman dates almost fifty years, a strong debate still survives on the possibility that speech understanding does not rely on sensory processing alone. In my presentation I will provide evidence that Liberman was substantially right and that a motor framework for language processing does exist, not only for speech but also for language syntax. To this purpose I will present very recent TMS data, patients studies, and computational models, all converging in the same direction.

Kevin O'Regan, Descartes University Paris and CRNS France

Constructing space

J. Kevin O'Regan [1], Alban Laflaquière [2] & Alexander Terekhov [2]

1- Laboratoire Psychologie de la Perception – CNRS, Université Paris Descartes, Paris
2- Institut des Systèmes Informatiques et de Robotique – CNRS, Université Pierre et Marie Curie, Paris

Space seems to be given to us a priori, as a container which contains "stuff" like "objects" that can "move". Among the objects are our "bodies", which we can use to "act upon" the objects. These actions obey certain mathematical constraints dictated by the fact that space is three-dimensional and more or less Euclidean.

But for our brains such goings-on are only nerve firings, and nerve firings can occur without there being such a thing as space outside the body. So how can the nerve firings lead to space? Evolution may have built our brains to create space, but how can this have come about? What patterns of nerve firing enable this to be done?

The problem is complicated by the fact that sensory receptors do not signal spatial properties directly. For example in vision, distance is confounded with size; position is confounded with eye and body posture. In hearing, distance must be deduced from a combination of intensity and inter-aural time differences. Another problem is that in order to deduce spatial properties of the environment, the brain needs to know something about the body's own spatial structure. And this is signalled by proprioceptive receptors whose outputs are also ambiguous. Finally, some a priori knowledge of body structure would seem to be necessary. So how can space arise from such a magma of neural firings?

When we think carefully about what space really is, we realize that we cannot hope to find space as a feature of the environment that is directly perceived. Space is a construction that allows us to describe our worlds more conveniently. It is a collection of invariants linking neural output to neural input.

Extracting such invariants must allow the brain to define concepts like "body", "environment", "action", "object", "position", "movement", "distance". Underlying such concepts are further facts like Separability: What I do here is generally not affected by what I do there; Relativity: Objects can be placed in the same spatial relation here as there; Impenetrability: Generally two objects cannot simultaneously occupy the same position; Group structure: some actions done on objects obey certain combinatorial rules independently of what the objects are. All of these notions are a few of many that

are aspects of what we call space, but not all may be necessary for animals to function properly. Even humans' notion of space may not rigorously encompass all these notions.
To understand better what are the basic concepts underlying the notion of space, a way to proceed is to build artificial agents of different degrees of complexity and see what notions of space they require in order to function. In my talk, I will present different agents illustrating different aspects of space, and will speculate how the underlying invariants could be learnt. I will show a naive agent that understands space as a set of "viewpoints from which things can be observed". I will show how this agent can determine the dimension of this space and acquire its metric properties.

Marco Zorzi, Padua University, IT

Deep learning of visual numerosity

Numerosity estimation is an evolutionarily ancient ability that is thought to be foundational to mathematical learning in humans. It is widely believed that this ability is supported by a specialized mechanism, known as the Approximate Number System (ANS), which in primates has a specific neural substrate in the intraparietal sulcus. The ANS would represent numerosity in an abstract way and its representational precision, also known as "number acuity", is thought to be causally linked to both typical and atypical pathways of numeracy acquisition. I will show that visual numerosity emerges as a high-order statistical feature of images in "deep" neural networks that learn a hierarchical generative model of the sensory input without supervision. The model can also readily account for the modulation of numerosity estimation performance induced by manipulations of continuous visual properties of the stimuli. Finally, I will show that the model's number acuity during learning improves in a way that mirrors the human developmental trajectory, whereas the atypical developmental trajectory of dyscalculic children can be simulated in the model by limiting the computational resources that are available for learning the generative model.

Matt Schlesinger, Southern Illinois University, USA

The "Eyes" Have It: Toward an Active-Vision Model of Early Perceptual Development

The concept of active vision is well-established within the fields of machine vision and human perception, and yet most computational models of perceptual development in human infants fail to leverage this approach. The emerging discipline of developmental robotics provides an ideal opportunity to not only exploit active-vision as a guiding principle for understanding how perception develops, but also to help bridge the gap between models of perception and the empirical data gleaned from behavioural studies. In this talk, I survey a decade-long progression of developmental models, which are incrementally advancing toward a comprehensive account of early perceptual development that captures infants' visual activity across multiple timescales.

POSTER SESSION 1

Alan Broun, Bristol University, Robotics Laboratory (UK)

Using Exploratory Motions to Autonomously Build and Exploit a Kinematic Model

Robots often require models, in order to be able to carry out actions, to control themselves, and to interact with objects around them. Possible model types include kinematic, dynamic, and 3D models, to name but a few. The need for models, is commonly answered by having the designers of a robotic system manually provide them. For example, kinematic, and 3D models can be built from the CAD files used to design the robot. A disadvantage of manually providing models is that they may be costly, or time consuming to produce. Also, a model may need to be changed over the lifetime of a robot, as parts are upgraded, or the performance of the robot degrades to due to wear and tear. Updating models may be difficult, and may be particularly hard if measurements need to be taken, but the robot is in a hard to reach, or hazardous location.
Our work looks at bypassing the need to manually build models, by enabling robots to autonomously build the models that they need themselves. To do this, we have the robot perform exploratory actions in order to gather information, and to learn about its body. Our system starts from a state of very little knowledge, and uses exploratory motions, first to detect and model the robot's hands, and then to measure the position and orientation of the robot's joint axes. Having built these models, we show how the robot is able to exploit the models, planning movements, and also homing its joints after powered on, by using vision.

Amir Aly, ENSTA ParisTech (FR)

Para-Verbal, Verbal, and Non-Verbal Behavior Understanding-Generation Based on Human Internal States and Psychological Dimensions

The major research axes in my PhD focus on understanding human personality and internal states in order to better understand the context of interaction and to generate an appropriate robot behavior through three modalities of communication (i.e. Para-Verbal, Verbal and Non-Verbal modalities).

Anara Sandygulova, School of Computer Science and Informatics, University College, Dublin (DE)

Individual Robot Interaction (IRI)

In environments where robotic systems are deployed people often have different requirements. Resources and tasks present in these environments are often assigned to more than one person at a time. However, current robotic systems lack the support of multi-user task achievement while ensuring seamless personalized interaction. My research aims to exploit the advantages of ubiquitous monitoring services of intelligent robotic systems to distinguish individuals in a shared environment in order to provide personalized, controllable and effective interaction for its every occupant.

Christopher Beck, Bristol University, Robotics Laboratory (UK)

Manipulation of Objects for the Extraction of Text (MOET).

Christopher B., Broun A. & Trust L.

Embedded text on an object can hold crucial information for the holder. This information can range from a sell by date to what the object contains. My work looks to locate and understand text and its structure in unconstrained natural scene images. The Project as a whole presents a robotic platform that can grasp and manipulate objects so as to discover text regions, and then based on the text and 3D model information gained to further manipulate the object to enhance and explore these regions.

Filipe Neves Dos Santos, Faculty of Engineering, University of Porto (PT)

HySeLAM - Hybrid Semantic Localization and Mapping

Mobile robotics which presupposes interaction with humans, requires new paradigms of the concept of intelligence. The robot's ability to understand and perform tasks such as: "Robot, go to the office and bring me the pen that is on the table", is a requirement. Most approaches to the localization and mapping layer are not in tune with the higher layers to solve this kind of task. The robot's ability to reason about what it senses and knows, as well as to acquire and share knowledge when interacting with a human voice, are capabilities required for the success of this cooperation. Unlike traditional SLAM (Simultaneous Localization and Mapping) methods, which only interpret sensor information at the geometric level, these capabilities require an environment map representation similar to that of humans. This works presents a hybrid approach (metric and semantic) for the localization and mapping layer, in order to reach a human-like environment map representation. This will allow for the development of a new strategy that will enable the robot to: complete and build this knowledge through human interaction; associate sets of characteristics of observations to words, which are, in turn, associated to objects and places; and reason at a semantic level about this knowledge and its own observations.

Haris Balta, Royal Military Academy of Belgium, Department of Mechanical Engineering (MSTA)

Increasing Situational Awareness through Outdoor Robot Terrain Traversability Analysis based on Time-Of-Flight Camera

One of the key challenges for outdoor mobile robots is to navigate autonomously in an unstructured and dynamic environment. In order to accomplish this goal, mobile robotic system need to auto - determine the suitability of the terrain around them for traversal. Traversability estimation is a challenging problem, as the traversability is a complex function of both the terrain characteristics, such as slopes, vegetation, rocks, soils, etc. and the robot mobility characteristics, i.e. locomotion method, wheels, etc. In this poster we present an approach for outdoor terrain traversability analysis based on 3D information (time-of-flight-camera) for terrain classification. Integrated in autonomous robot control architecture, terrain traversability classification increasing the environmental situational awareness and enables a mobile robot to navigate autonomously in an unstructured outdoor environment.

Jekaterina Novikova, Department of Computer Science, University of Bath (UK)

Awareness in Human-Robot Collaboration

Our research aims to bridge human-robot interaction (HRI) and artificial intelligence (AI) areas in order to identify the key parameters of collaboration in the context of human-robot joint action, and to find a scheme for combining them into a coherent theoretical framework. The important question of HRI is what are the principal concepts that stimulate efficient collaboration between robots and humans. In this context, awareness becomes one of the important keys of the research. In our research awareness is defined as a model of overlap between focus and nimbus and we believe that such a model can be generalized to all types of awareness, not only a spatial one. We analyse the effect of awareness on the performance of joint action task.

Kristina Rebrova, Comenius University (SK)

A robotic model of mirror-neuron based action-understanding

Action understanding belongs to crucial capacities of human and animal cognition and two rival theories may be distinguished (Rizzolatti & Sinigaglia, 2010). The "visual theory" states that action understanding functions solely on visual basis, whereas the "direct matching theory" claims that understanding of the observed goal-driven action is mediated by motor areas, namely the mirror neurons. The newer, reconciling view suggests that action understanding depends on mutual interaction between visual and motor areas (Tessitore et al., 2010) and that computational modelling might prove very valuable in exploring and explaining the role of mirror neurons in human and animal cognition (Oztop et al., 2012). In line with this research we present a multi-layer connectionist model of action understanding circuitry. The model is composed of several processing modules and hierarchically organized. On the topmost level we introduce a modification of biologically plausible GeneRec algorithm (O'Reilly, 1996), that incorporates the bidirectional interaction of visual area STS and mirror neurons. We implemented the model in a simulated iCub robot learning the grasping task.

POSTER SESSION 2

Martin Fodstad Stoelen, Universidad Carlos III de Madrid (ES)

Experiments on Online Associative Learning: Towards Mutual Adaptation between Robot and User?

Humans and animals are able to learn while interacting with the environment and with other agents. Learning algorithms in robotic systems are typically run offline, which allows for a more comprehensive processing of the sensory data generated. Online approaches might be worth exploring if the learning is part of the interaction with another adaptive agent however. Gradual changes in behavior are likely easier to predict for the partner, and may help the agents negotiate a common language for performing tasks. That is, it may lead to a mutual adaptation between the agents. Two case studies on online associative learning for human-robot interaction are discussed. Both use simple neural networks with Hebbian learning rules, but differ in the integration of the networks in the complete sensorimotor loop. This led to an adaptive collision-limitation behavior and a simple interactive learning approach for manipulation tasks.

Mriganka Biswas, University of Lincoln (UK)

Building a long term Human-Robot relationship: How emotional interaction plays a key role in attachment

The current research aims to develop a system for long-term relationships with a robot, based on emotional interaction. It is hoped that this research can improve the communication and social interaction behaviour between a human and robotic companion and help to understand the process of making relationships. The first experiment of the research is to prove the hypothesis, which is, 'the robot can engage with the user in long-term relationship based on emotions which demonstrate the important aspects of human-human and human-robot relations'. This experiment is being conducted with the robot head called Erwin, which is capable of simple prototypical emotions and will be conducted via a simple 'wizard of oz' procedure.

Roy Someshwar, Ben Gurion University of Negev, Israel & Umea University (SW)

An Adaptive H-R Synchronization Model: Towards developing "Conscious Robots"

Human-Robot (H-R) synchronization is one of the challenges of Human-Robot Collaboration (HRC). The lack of cognitive ability in Robot makes synchronization difficult. A novel method is presented that provides a balance between synchronization and autonomy, typically observed in human behavior. The method is based on the ability of the chaotic neuronal networks to generate creative 2D and 3D patterns [Gontar V, 2007]. It is shown that these patterns contain very rich information which could be effectively used for robot decision making. Each neuron of the proposed neuronal network is simulated by difference equations with embedded chaotic regimes under appropriate parameters. This information is then fed into the biologically inspired MLP(Multi-Level Pattern) algorithm [Madison,2009] which is then translated into real-time motor commands of the robot. The resulting behavior is completely deterministic (as the solution of a non-linear dynamical system), adaptive and shows a creative emergent behavior. This is a small step towards developing "Conscious Robots".

Sao Mai Nguyen, Flowers Team, Inria, Bordeaux (FR)

Interactive Learning Gives the Timing to an Intrinsically Motivated Robot Learner

This poster presents a study on an interactive learning system that couples two learning strategies: internally guided learning and social interaction, for robot learning of motor skills. We present Socially Guided Intrinsic Motivation with Interactive learning at the Meta level (SGIM-IM), an algorithm for learning forward and inverse models in high-dimensional, continuous and non-preset environments. The robot actively self-determines: at a meta level a strategy, whether to choose active autonomous learning or social learning strategies; and at the task level a goal task in autonomous exploration. We illustrate through 2 experimental set-ups that SGIM-IM efficiently combines the advantages of social learning and intrinsic motivation to be able to produce a wide range of effects in the environment, and develop precise control policies in large spaces, while minimising its reliance on the teacher, and offering a flexible interaction framework with humans.
We show through 2 illustration experiments that the Socially Guided Intrinsic Motivation with Interactive learning at the Meta level algorithm could learn to complete multiple tasks in both deterministic and stochastic environments. It can also manage the interaction with both a human teacher whose demonstrations cannot be exactly reproduced by him, and a specialised teacher who only gives demonstrations in a restricted subspace of the task space. In both experiments, our robot learns efficiently and faster all possible tasks, in continuous task and action spaces. The robot could learn high-dimensional models for highly redundant problems, which

constitute a typical issue for humanoid robots who evolve in continuous and unpreset environments and who have to control their numerous degrees of freedom with high redundancy. The SGIM-IM learner can handle its interaction with human users owing to interactive learning. It automatically balances learning by imitation and autonomous learning, by taking in account both its need and the cost of an interaction, so as to minimise the teacher's effort and maximise the impact of each demonstration. It thus offers a flexible interaction between a robot and the human users.
The Socially Guided Intrinsic Motivation with Interactive learning at the Meta level algorithm has a 3-layered hierarchical structure which includes two levels of active learning. Based on its exploration in the action space, it actively chooses in the task space which goals could be interesting to target, and selects on a meta level between autonomous learning or social learning strategies. It can actively interact with the teacher instead of being a passive system. This structure could easily be extended to take into account more complex social interaction scenarios, such as an interaction with several teachers, where the learner can choose who it should imitate.

Umar Shoaib, DAUIN, Politecnico di Torino (IT)

Communication systems for deaf blind

Communication is an essential phenomenon and integral part of our daily life. The communication systems allow us to communicate with anyone, at any time, and from anywhere in world, suggest that being without communication is unnatural and isolating our self. People who are deaf and blind can experience extreme social and informational exclusion due to their inability to converse easily with others. Hearing inability and blindness implies limitations in the communication capabilities, personal and learning autonomy. Deaf blind people use tactile sign language to communicate with others. The linguistics information is not conveyed by visual means unlike sign languages but interactions with others requires being in physical proximity, knowledge of sign language (SL) or finger spelling, and engagement in "hands-on-hands" communication mechanism. Deaf blind people cannot even communicate with another person on the opposite side of the same room, rather than other side of the world.

Wang Liyu, Bio-Inspired Robotics Lab, ETH Zürich (CH)

Towards automatic design and use of reconfigurable end-effectors synthesized on-the-fly

Recent progress in self-reconfigurable technologies has shown the feasibility of a robot synthesizing its own body structures out of 'raw material' for realistic tasks. However, higher-level functions such as automatic design of necessary structures given a task or automatic use of synthesized structures to perform the task, are lacking. The poster firstly presents the mechanism of structure synthesis and the results, and then propose possible use of existing methods from developmental robotics to achieve these higher-level functions.

Anestis Fachantidis, Aristotelian University of Thessaloniki (GR)

Transfer Learning for Humanoid Robotics: A Reinforcement Learning approach

Reinforcement Learning (RL) methodologies have been used successfully in the past in many Robotics settings. However, Transfer Learning (TL) methodologies using RL have not been extensively studied. When transferring knowledge between two robot tasks with different state representations or actions, past knowledge must be efficiently mapped so that it assists learning. The majority of the existing RL approaches use a single pre-defined mapping given by a domain expert. In the complex and highly stochastic domain of humanoid robotics there may not be an intuitive TL mapping. Moreover, a single and fixed mapping may not be appropriate. To overcome these limitations and allow autonomous transfer learning for humanoid robotics, this work presents a multiple-mappings TL algorithm named COMBREL and its application in the iCub robotic simulation platform. COMBREL is able to autonomously find the correct knowledge mappings between two different iCub tasks and to dynamically change its mapping selection according to iCub's state. Experimental results show that the use of multiple inter-task mappings, accompanied with a selection mechanism, can significantly boost the performance of transfer learning in robotics, compared to learning without transfer and compared to using a single hand-picked mapping. Moreover this can be a computationally efficient method for transfer learning between complex humanoid tasks.

Thanos G. Stavropoulos, Aristotelian University of Thessaloniki (GR)

A Ubiquitous, Intelligent system for power management in a Smart University

The Smart IHU project aims to realize a Smart University infrastructure, to provide energy monitoring, management and savings. To that end, it is utilizing a large-scale deployment of heterogeneous wireless sensor and actuator networks that provide extensive environmental data, such as power, temperature, humidity, luminance, air CO2 concentration, motion/smoke detection, and appliance power management. A Semantic Web Service middleware unifies all those functions, both syntactically and semantically. That enables applications such as deductive-logic expert systems, to manipulate the infrastructure, in order to achieve energy savings and comfort.

Day 3: March 20

TUTORIAL 1

Eirini Balta and **Panagiotis Dimitrakis,** Cognitive Systems Research Institute, Athens (GR)

Towards semantic memory for Robots

Do robots need a semantic memory? How can a semantic memory give an advantage to a robot performing common everyday tasks? In this tutorial we will introduce a specific semantic memory architecture, the PRAXICON, and explain the entities, characteristics, structural design and knowledge representation in this approach. The content is equally, if not more, important to the design, so we will also discuss on the actual content origin and our future vision for more knowledge acquisition. Going to more practical issues, we will introduce the use of PRAXICON in robotic applications: from simple knowledge retrieval to advanced reasoning. As an application regarding robotic vision we will explain how the semantic memory can assist an object recognition application by putting everything into context. And as a more complicated application, we will focus on the use of PRAXICON in studying actions and interaction with objects on the way to currying out commands given from a human agent.

TUTORIAL 2

Argiro Vatakis, Cognitive Systems Research Institute, Athens (GR)

Multisensory synchrony and duration: From perceiving to enacting timing

An important issue in the framework of Cognitive Science is time perception. Time perception has been studied from various aspects (e.g., order, duration), under different conditions (e.g., simple vs. complex stimuli), and from different perspectives (e.g., philosophical, psychological). Two of the major and current areas of the study of time perception are those of synchrony perception (i.e., how one perceives a temporally unified event) and duration perception. Thus, an overview of the major findings in these two areas will be presented from a multisensory perspective. Additionally, we will present current research findings on the embodiment of time and the future directions on understanding timing in humans. The aim of this tutorial is to familiarize oneself with the major research findings in human time perception and, thus, provide the ground knowledge for future application of timing in artificial agents.

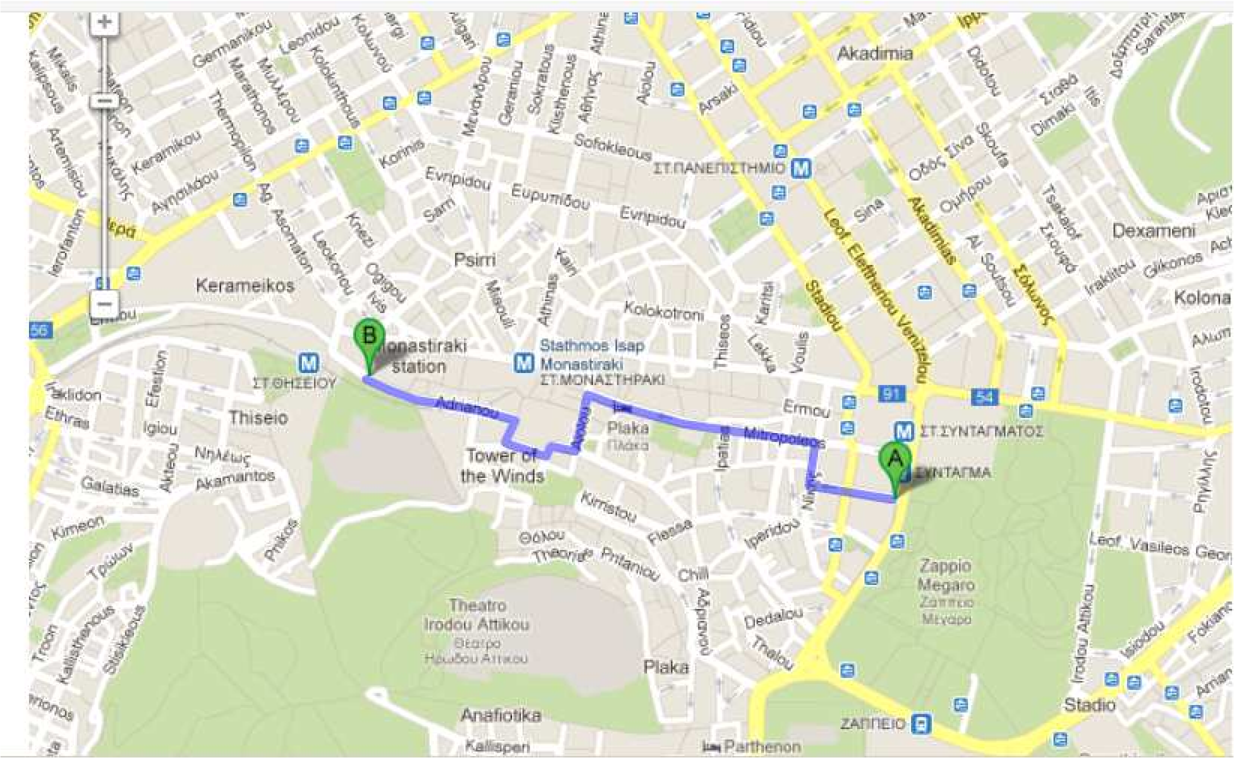
Michail Maniadakis, Foundation for Research and Technology - Hellas (FORTH), Crete (GR)

Entimed Cognition

The capacity to experience and process time is fundamental for most of our daily activities. However, cognition in artificial systems is currently not modulated by temporal features as humans experience them and this fact greatly obstructs robotic agents in developing sophisticated cognitive skills. Without doubt, the ability to perceive and process time is not an optional extra but a necessity towards the development of truly autonomous and intelligent machines. In the current talk we will discuss that artificial cognition is necessary to be not only embodied, but also “entimed”, in order to facilitate the seamless integration of artificial agents into the inherently time-structured human environments. The perception and processing of time is an innate and particularly useful capacity for animals and humans (we make associations between asynchronous events in the past, present and future, we allocate cognitive resources to tasks in a dynamic manner, we shift attention to a particular past or future period, we recall experiences based on time and more). Capitalizing on the concepts of embodied and entimed cognition, the newly implemented artificial agents will be situated both in space and time, therefore accomplishing seamless and active integration into human societies.

Kuzina Restaurant

Walking directions from the Amalia Hotel to the Kuzina Restaurant (http://www.kuzina.gr)



Amalia Hotel Athens
Leoforos Vasisilis Amalias 10, Athina 105 57, Greece

1.	Head **west** on **Xenofontos/Ξενοφώντος** toward **Xenofontos/Ξενοφώντος** About 2 mins	go 190 m total 190 m
2.	Turn right onto **Nikis/Νίκης** About 1 min	go 92 m total 290 m
3.	Turn left onto **Mitropoleos/Μητροπόλεως** About 7 mins	go 650 m total 900 m
4.	**Mitropoleos/Μητροπόλεως** turns left and becomes **Pl. Monastirakiou/Πλ. Μοναστηρακίου**	go 40 m total 1.0 km
5.	Turn right onto **Pandrosou/Πανδρόσου**	go 10 m total 1.0 km
6.	Turn left to stay on **Pandrosou/Πανδρόσου**	go 10 m total 1.0 km
7.	Continue onto **Areos/Άρεως**	go 43 m total 1.0 km
8.	Turn right onto **Adrianou/Αδριανού** Destination will be on the left About 4 mins	go 350 m total 1.4 km

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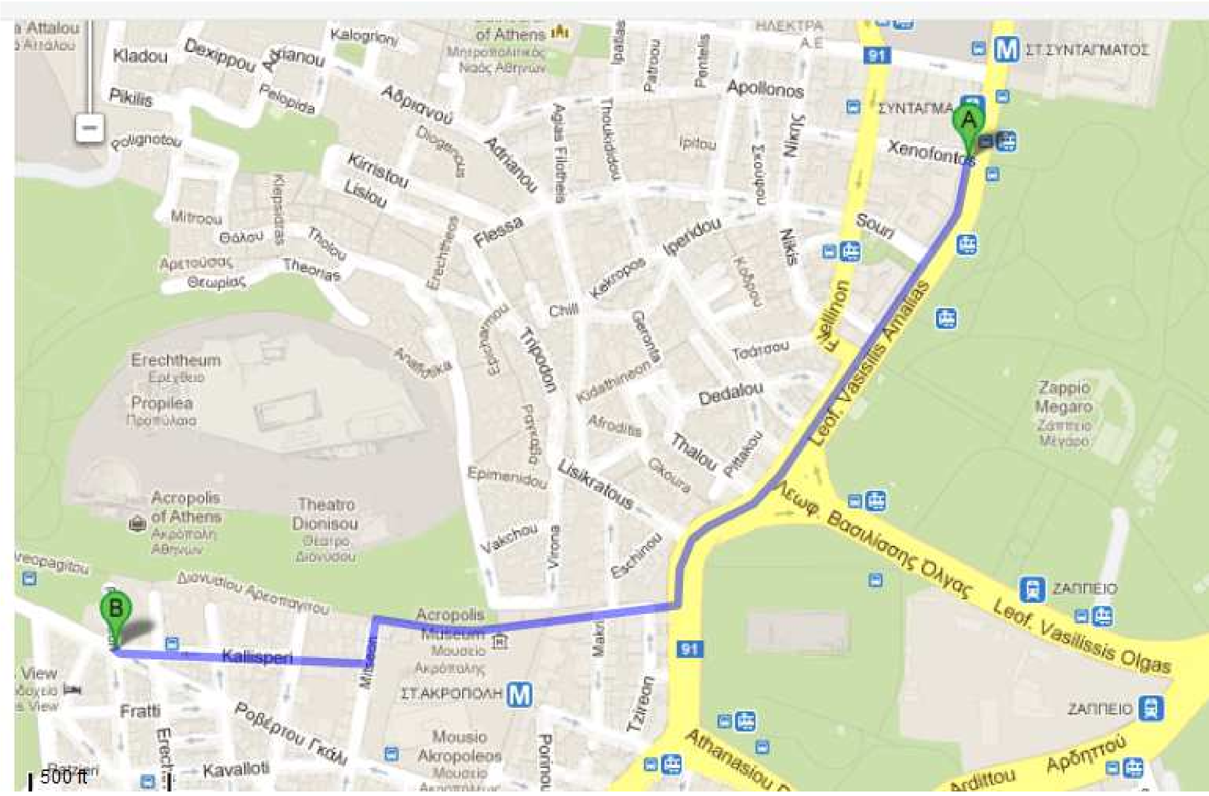
Kuzina Restaurant
Adrianou 9, Athina 105 55, Greece

Strofi Tavern

Walking directions from the Amalia Hotel to the Strofi Tavern (http://www.strofi.gr)



Amalia Hotel Athens
Leoforos Vasisilis Amalias 10, Athina 105 57, Greece

1.	Head **south** on **Leof. Vasisilis Amalias/Λεωφ. Βασιλίσσης Αμαλίας** toward **Souri/Σουρή** About 7 mins	go 600 m total 600 m
2.	Turn right onto **Dionisiou Areopagitou/Διονυσίου Αρεοπαγίτου** About 5 mins	go 350 m total 950 m
3.	Turn left onto **Mitseon/Μητσαίων**	go 49 m total 1.0 km
4.	Turn right onto **Kallisperi/Καλλισπέρη** About 3 mins	go 270 m total 1.3 km
5.	Continue onto **Rovertou Galli/Ροβέρτου Γκάλι** Destination will be on the left	go 8 m total 1.3 km

Strofi Tavern
Rovertou Galli 25, Athina 117 42, Greece

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