PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Riccardo Caccavale

XXIX Cycle

Training and Research Activities Report – First Year

Tutor: Alberto Finzi

1. Informations

Riccardo Caccavale, MS title: Computer Science (Computational Models) – Federico II

XXIX Cycle- ITEE – Università di Napoli Federico II

Tutor: Alberto Finzi

2. Study and Training activities

Courses:

Elaborazione del Linguaggio Naturale – MS in Computer Science.

Semantic Web – MS in Computer Science.

Europrogettazione – ad hoc ITEE.

Three core issues for the Internet: things, security ad economics – ad hoc ITEE.

Seminars:

Verifica e validazione di sistemi safety critical.

Verification of mobile agents in partially known environment.

Site reliability engineering in Google.

Methods and tools for smart device integration and simulation.

Heterogeneities in temporal networks emerging from adaptive social interactions.

Quantum teleportation.

Developmental robotics for embodied language learning.

Nano-carbon based components materials for high frequency electronics.

Fractional programming for energy efficiency in wireless networks.

Thowards agile flight of vision-controlled micro flying robots.

	Credits year 1								Credits year 2								Credits year 3									
		1	2	3	4	5	6			1	2	3	4	5	6			1	2	3	4	5	6			
	Estimated	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	Summary	Estimated	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	Summary	Estimated	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	Summary	Total	Check
Modules	18					3	12	**15**	15							**0**								**0**	15	30-70
Seminars	13				2,8	2,2		**5**	4							**0**								**0**	5	10-30
Research	34	10	10	8	8	7	7	**50**	45							**0**								**0**	50	80-140
	65	10	10	8	11	12	19	**70**	64	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	70	180

3. Research activity

Title:

An Architecture for Attentional Regulation in Robotic Cognitive Control.

Description:

This research activity concerns the design and development of an architecture for robotic cognitive control [Bot01, Pos75] which supports mechanisms of attentional regulation [Norm86] and temporal allocation of attention. In this work, our aim is to endow an autonomous robotic system with executive functions such as cognitive control, working memory and attention [Coh04], improving decision-making processes and behavior management [Breaz02].

The architecture proposed integrates a behavior-based system, a process for the dynamic generation of hierarchical tasks, and top-down/bottom-up attentional regulation mechanisms [Norm86, Coop06]. Specially, the cognitive control cycle involves three main modules: a behavioral pool, a working memory, and a long term memory. The behavioral pool contains a set of behaviors which may contribute to the execution of a complex cognitive task. The working memory contains a representation of hierarchical tasks [Arb87] in the attentional set of the system. This includes all the tasks the system is executing or willing to execute [Mill56]. Finally, the long term memory is a repository contains the definition of all the tasks available to the system [Lai87]. Each behavior of the behavioral pool is endowed with an adaptive clock [Bur10] that regulates the frequency of sensory sampling rate and action activation. This regulation tunes the resolution at which the behavior is monitored and controlled. For each behavior, the adaptive clock is modulated by an evaluation function (that we call emphasis) which integrates both internal and external stimuli. Furthermore, since no explicit mechanism is provided to avoid erratic behaviors, we exploit the evaluation function to solve these conflicts maintaining [Moz98] a coherent behavior during the execution [Coop00].

The attentional framework has been implemented and tested in different case studies concerning robot navigation and motion, and human-robot interaction (inspired by the

SAPHARI project) [Cac14a, Cac14b, Cac14c]. In the mentioned cases, the robotic system is to emphasize its actions according with the context, the dialogue [Luc13] and the interpretation of the human behavior (gesture, voice, face, etc.) [Ros13] showing how the attentional regulation should be useful to manage multiple concurrent tasks in dynamic environments. Further we investigate the attentional regulation of HTN structured tasks during plan execution [Fiore14, Lalle14], where the robotic system is to adapt its actions according with the plan and the interpretation of the human behavior.

References:

[Arb87] M. A. Arbib, E. J. Conklin, and J. A. C. Hill, From schema theory to language. Oxford University Press, 1987.

[Bot01] M. M. Botvinick, T. S. Braver, D. M. Barch, C. S. Carter, and J. D. Cohen, “Conflict monitoring and cognitive control.” Psychological review, vol. 108, no. 3, p. 624, 2001.

[Breaz02] C. Breazeal, Designing Sociable Robots. MIT Press, 2002.

[Bur10] E. Burattini, S. Rossi, A. Finzi, and M. C. Staffa, “Attentional modulation of mutually dependent behaviors,” in Proc. of SAB 2010, 2010, pp. 283–292.

[Cac14a] Attentional Top-down Regulation and Dialogue Management in Human-robot Interaction, R. Caccavale, A. Finzi, L. Lucignano, S.Rossi, M. Staffa. In Proc. of HRI-2014.

[Cac14b] Attentional regulations in a situated human-robot dialogue. R. Caccavale, E. Leone, L. Lucignano, S. Rossi, M. Staffa, A. Finzi. In Proc.of Ro-MAN-2014.

[Cac14c] Attentional Top-down Regulations in a Situated Human-Robot Dialogue, R. Caccavale, A. Finzi, L. Lucignano, S.Rossi, M. Staffa, in HRI-2014 workshop on "Attention Models in Robotics: Visual Systems for Better HRI".

[Coh04] J. Cohen, G. Aston-Jones, and M. Gilzenrat, “A systems-level perspective on attention and cognitive control,” Cognitive neuroscience of attention, p. 71, 2004.

[Coop00] R. Cooper and T. Shallice, “Contention scheduling and the control of routine activities,” Cognitive Neuropsychology, vol. 17, pp. 297–338, 2000.

[Fiore14] On Planning and Task achievement Modalities for Human-Robot Collaboration. M. Fiore, A. Clodic and R. Alami in ISER 2014.

[Lai87] J. E. Laird, A. Newell, and P. S. Rosenbloom, “Soar: An architecture for general intelligence,” Artificial intelligence, vol. 33, no. 1, pp. 1–64, 1987.

[Lalle14] Raphael Lallement, Lavindra de Silva, and Rachid Alami. HATP: An HTN Planner for Robotics. In 2nd ICAPS Workshop on Planning and Robotics, PlanRob 2014, 2014.

[Luc13] L. Lucignano, F. Cutugno, S. Rossi, and A. Finzi, “A dialogue system for multimodal human-robot interaction,” in Proc. of ICMI, 2013, pp. 197–204.

[Mill56] G. A. Miller, “The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information,” The Psychological Review, vol. 63, pp. 81–97, 1956.

[Moz98] M. C. Mozer and M. Sitton, “Computational modeling of spatial attention,” Attention, vol. 9, pp. 341–393, 1998.

[Norm86] D. A. Norman and T. Shallice, “Attention to action: Willed and automatic control of behavior,” in Consciousness and self-regulation: Advances in research and theory, 1986, vol. 4, pp. 1–18.

[Pos75] M. I. Posner and C. R. R. Snyder, “Attention and cognitive control,” in Information Processing and Cognition, 1975, pp. 55–85.

[Ros13] S. Rossi, E. Leone, M. Fiore, A. Finzi, and F. Cutugno, “An extensible architecture for robust multimodal human-robot communication,” in In Proc. of IROS-2013, 2013.

Collaborations:

LAAS-CNRS laboratory, Toulouse (FR). Technology University of Munich, Munich (DE).

4. Products

Publications:

Attentional Regulations in a Situated Human-Robot Dialogue, in proceedings of ROMAN-2014 (International conference paper).

Attentional top-down regulation and dialogue management in human-robot interaction, Proceedings of the 2014 ACM/IEEE international conference on Human-robot interaction.

Attentional Top-down Regulations in a Situated Human-Robot Dialogue. HRI-2014 workshop on Attention Models in Robotics: Visual Systems for Better HRI (reviewed workshop paper at the conference HRI-2014).

Attentional Top-Down Regulations in a Situated Human-Robot Dialogue. ICRA workshop Robots in Homes and Industries: where to look first? (reviewed workshop paper at the conference ICRA-2014).

Deliverables:

Deliverable 7.5.1 for SAPHARI project (WP7).

In preparation:

Paper for IROS-2015, International Conference on Intelligent Robots and Systems.

5. Conferences and Seminars

Participation to the Conference ROMAN2014 (Edinburgh).

Participation to the Integration Meeting SAPHARI (Rome).

6. Activity abroad

Integration Meeting SAPHARI to LAAS-CNRS (Toulouse, 8/2/15 – 13/2/15).