



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Ersilia Vallefucoco

XXXII Cycle

Training and Research Activities Report – First Year

Tutor: Prof. Alessandro Pepino



Information

Ersilia Vallefucoco, MS in Biomedical Engineering, cum laude, in 2016 – University of Naples “Federico II”.
XXXII Cycle - University of Naples “Federico II”.
DIETI (University of Naples “Federico II”) and Centre SInAPSi (University of Naples Federico II”) finance my fellowship.
Tutor: Prof. Alessandro Pepino.

Study and Training activities

In the first year of PhD program, I attended the following seminars and courses:

Courses:

1. **Le imprese e la ricerca** (28/02/2017- 02/03/2017), ad hoc Modules, Dr. Marco Frizzarin, Business Manager della Ernst&Young, 4 CFU.
2. **Ethical, legal and social aspects of ICT and Robotics** (7/03/2017- 04/04/2017), ad hoc Modules, Prof. Guglielmo Tamburrini, 3 CFU.
3. **Satellite Remote Sensing: Open challenges and opportunities** (23/10/2017- 31/10/2017), ad hoc Modules, Prof. Giuseppe Ruello, 3 CFU.
4. **Sistemi Informativi** (09/2017- 12/2017), M.Sc courses, Prof.Vincenzo Moscato, 6 CFU.

Seminars:

1. **Cognitive Computing and Da Vinci Robot: Research proposal and discussion** (17/02/2017), Prof. Paolo Maresca, 0.2 CFU
2. **IBM Cognitive Computing: Challenges and Opportunities in Building an Artificial Intelligence Platform for business** (17/02/2017), Ing. Pietro Leo, 0.4 CFU.
3. **Smart Nanodevices for Theranostics** (24/02/2017), Ilaria Rea 0.3 CFU.
4. **How to organize and write a scientific rebuttal** (10/03/2017), Prof. Pasquale Arpaia, 0.4 CFU
5. **Fuzzy logic, genetic algorithms and their application to next generation networks** (10/03/2017; 11/03/2017), Prof. Leonard Barolli, 0.8 CFU.
6. **Scaling adaptive streaming systems with network support** (13/03/2017), Dr. Ali C.Begen, 0.3 CFU.
7. **Sound and music in Human Computer Interaction** (28/03/2017), Prof. Antonio Rodà, 0.4 CFU.
8. **Living bots and alter ego** (04/04/2017), Prof. Marco Gori, 0.4 CFU.
9. **DataFlow SuperComputing for BigData** (12/04/2017), Prof. Veljko Milutinovic, 0.6 CFU.
10. **Exploiting Speech Production Knowledge for Deep Learning-based Automatic Speech Recognition** (9/05/2017), Dott. Leonardo Badino, 0.4 CFU.
11. **Power system stability and synchronization: Application to the lossy power grid system** (30/06/2017), Prof. Navdeep M.Singh, 0.2 CFU.

- 12. **A shared memory parallel heuristic algorithm for the large-scale p-median problem** (12/09/2017), Prof. Igor Vasilyev, 0.2 CFU.
- 13. **Medical Imaging: why not let the data speak for themselves?** (26/10/2017), Marco Aiello, 0.4 CFU.
- 14. **Graph Queries: Generation, Evaluation and Learning** (18/12/2017), Pro.ssa Angela Bonifati, 0.4 CFU.

Credits Summary

| | | Credits year 1 | | | | | | |
|-----------------|-----------|----------------|---------|---------|---------|---------|---------|-------------|
| | Estimated | 1 | 2 | 3 | 4 | 5 | 6 | Summary |
| | | bimonth | bimonth | bimonth | bimonth | bimonth | bimonth | |
| Modules | 20 | 4 | 3 | | | 3 | 6 | 16 |
| Seminars | 5 | 2,8 | 1,4 | 0,2 | 0,2 | 0,4 | 0,4 | 5,4 |
| Research | 35 | 5 | 5 | 7 | 7 | 5 | 6 | 35 |
| | 60 | 12 | 9,4 | 7,2 | 7,2 | 8,4 | 12 | 56,4 |

Research Activity

Immersive gaming Simulation For Inclusion.

The personalization in Serious Game for people with Autism Spectrum Disorder.

In my PhD, I study application of Immersive Gaming Simulation, know as Serious Game, in the field of Rehabilitation Engineering. When we talk about Rehabilitation Engineering, we intend an “application of engineering sciences to design, develop, adapt, test, evaluate, apply, and distribute technological solutions to problems confronted by individuals with disabilities in functional areas, such as mobility, communications, hearing, vision, and cognition, and in activities associated with employment, independent living, education, and integration into the community¹”.

The rehabilitation process for people with disabilities often imply the design and development of assistive devices in order to promote inclusion into society, commerce and recreation. Therefore, the aim of Rehabilitation Engineering is to support and increase the potential of people with disabilities to achieve their goals using technology.

In particular, I study and evaluated the use of Serious Game in order to help and support people with Autism Spectrum Disorder.

Research Description

Over the last decade, several studies evaluated the use of Serious Games as tools to encourage the development of communication, the process of learning, and social behaviour in people with Autism Spectrum

¹ Rory A Cooper, 1995. Rehabilitation Engineering Applied to Mobility and Manipulation. Taylor & Francis Group. New York.

Disorder (ASD) alongside traditional therapeutic approaches. A Serious Game (SG) is a simulation with a videogame structure whose purpose is to promote the development of important skills and strategies in order to increase the cognitive and intellectual abilities of the users². Today, Serious Games also called learning games, educational games, immersive learning simulations and game-based learning, are very popular and they get significant market share in the gaming industry³. Different studies evaluated the Serious Games use as a tool to support traditional therapy for people with Autism Spectrum Disorder (ASD) in order to improve communication, learning, social behaviour and, in different ways, motor abilities⁴.

Autism Spectrum Disorders are a variety of disorders that affect social and communication skills and, in a different way, motor and language skills⁵. In United States, as reported by the Centers for Disease Control and Prevention⁶, Autism Spectrum Disorders have been identified in 1 out of 68 children. Studies in Asia, Europe, and North America have identified individuals with ASD with an average prevalence of between 1% and 2%. In Italy, a project was promoted and funded by Ministry of Health in order to establish a National Observatory for the monitoring of Autism Spectrum Disorder. The following estimates have been obtained from the first data: North Italy 1/149, Centre Italy 1/94 and South Italy 1/98.

The majority of Serious Games aimed at people with ASD have been developed for therapy, education (learning and training), and to improve social communication skills. Serious Games, which are developed to improve the learning process, have the goal of helping children or teachers during the learning process.^{7,8,9} People with ASD often have difficulties in communicating with others through both verbal and non-verbal language. For these reasons, several Serious Games have been developed to reduce these difficulties¹⁰. People with ASD often have difficulties in recognizing, understanding and expressing their emotions, therefore several studies investigated the development and the improvement of affective skills in children with ASD through Serious Games^{11,12}.

It is not possible to indicate a specific intervention due to the complexity and variety of Autism Spectrum Disorders; in fact, the therapeutic path has to change according to the evolution and changes. In particular, conforming to the International guidelines for ASDs each strategy must be modulated according to the level of

² Botte B., Matera, C.M., Sponsiello, M., 2009. Serious Games tra simulazione e gioco. Una proposta di tassonomia, In *Journal of e-Learning and Knowledge Society*, vol.5, pp. 11-22.

³ Alvarez, J., Alvarez, A., Djaouti, D., Michaud L., 2010. Serious Games: Training & Teaching-Healthcare Defence & security-Information & Communication, IDATE.

⁴ Zakari, H.M, Ma, M., Simmons, D., 2014. A Review of Serious Games for Children with Autism Spectrum Disorders (ASD). In M. Ma, Oliveira M.F. e Baalsrud Hauge J. (Eds.), *SGDA*. Springer, Heidelberg, vol. 8778, pp. 93-106.

⁵ American Psychiatric Association, 2013. *Diagnostic and Statistical Manual of Mental Disorders*. American Psychiatric Association. Washington, 5nd edition.

⁶ Centers for Disease Control and Prevention (2016), Summary of Autism Spectrum Disorder (ASD) Prevalence Studies. <https://www.cdc.gov/ncbddd/autism/data.html>.

⁷ Bernardini, S., Porayska-Pomsta, K., Smith, T.J., 2014. ECHOES: An intelligent serious game for fostering social communication in children with autism. In *Information Sciences*, vol. 264, pp. 41-60.

⁸ Laertius, D., Filho, S.O., Leite, D., De Sales, M., 2015. Um Novo Conceito de Sistemas Interativo para Autistas com Prospecção de Dado de Sistemas de Recomendac. In Conference: XIII Workshop de Educação e Informática da Escola Regional de Computação Bahia, Alagoas, Sergipe, Salvador, BA.

⁹ Van Veen, M., de Vries, A., Cnossen, F., 2009. Improving Collaboration for Children with PDD-NOS using a Serious Game with Multi-touch Interaction. In CHI NL, Leiden, the Netherlands, pp. 17-20.

¹⁰ Anwar, A., Rahman, Md.M., Ferdous, S., Ahmed, S.I., 2011. A Computer Game-based Approach for Increasing Fluency in the Speech of Autistic Children. In 11th IEE International Conference on Advanced Learning Technologies, pp. 17-18.

¹¹ Alves, S., Marques, A., Queirós, C., Orvalho, V., 2013. LIFEisGAME Prototype: A Serious Game about Emotions for Children with Autism Spectrum Disorders. In *PsychNology Journal*, vol. 11, pp. 191-211.

¹² Serret, S., Hun, S., Iakimova, G., Lozada, J., Anastassova, M., Santos, A., Vesperini, S., Askenazy, F., 2014. Facing the challenge of teaching emotions to individuals with low- and high-functioning autism using a new Serious game: a pilot study. In *Molecular Autism*, vol. 5.

development of the subject and must be adapted to its environment. For these reasons, a personalised approach is of pivotal importance in developing Serious Games for people with ASD. It is necessary: to carry out a suitable customized intervention¹³ based on evolution and changes; to consider the personalization of both accessibility of technologies^{14,15} and content¹⁶ in the development of a SG aimed at people with ASD.

In a preliminary study, we evaluated the use of a Serious Game as a tool to support improve the learning of mathematical basics in children with ASD, promoting a personalised design. The prototype was attractive and enjoyable, with a good usability and the users showed a good answer. Now, I am studying the effects of personalization in Serious Game for children and teenagers with ASD. In particular, the research aims to assess whether the inclusion of elements of personalization in the serious game can improve, or not, the acquisition of skills and skills conveyed through the game. A cross-sectional design was used to explore activity participation and competence in children and teenager with ASD; the sample for the current study included 10 children and teenagers with ASD. A collaboration has started with “Centro Medico Riabilitativo Pompei”, in fact, the participants were recruited with the support and collaboration of centre. Moreover, it was create a multidisciplinary team for this research biomedical engineer, psychologist, neuropsychiatrist and terapists. For all the participants in the study a diagnostic screening was performed, in particular, based on the standard diagnostic criteria (ADOS G, ADI-R, Vineland Adaptive Behaviour Scale-2, Child Behaviour Checklist 1.5-5, Griffiths Mental Developmental Scales, Parent Stress Index, Warwick-Edinburgh Mental Well-Being Scale-Italian version e “Scheda di Osservazione/valutazione Neuropsicomotoria” (SON)). Furthermore, a semi-structured interview was conducted for all participants to evaluate the degree of affinity towards the technologies and the level of attraction towards videogames.

In experimental phase, the participants will play two serious games, one personalised and another not personalised; these games are similar in design, game dynamics and missions but they are different for some personalised elements. In particular, it was individuated the following personalised elements: game scenery, scene objects, audio and type of missions. For both games an appropriate Game Design Document (GDD) was drop out in which all the principal components of the game as game overview, gameplay and mechanics, setting, story, characters, levels, technical aspect and management. The Serious Games can be classified as life-simulation game in fact they reproduce a real social context (supermarket) in which the player will achieve the proposed goals. Now, I am developing the two serious games, after, the testing phase will start with the participants.

I support and participated another research activities:

- Technical advice and support to draft a project for research and development, promoted by AGID (Agenzia per l'Italia Digitale) for Innovative applications of Virtual and Augmented Reality for people with Autism Spectrum Disorder. In particular, it was presented a solution with a partnership of SInAPSi, SANTEC SPA, ICAROS, Centro Medico Riabilitativo di Pompei and Specialmente noi Onlus.
- Analysis and Study the use of Serious Game as tool to sensitize children to a culture of differences. In this case, it was developed a serious game based on story “Pluralino e la scoperta della bellezza delle differenze”. This project was born in Centre SInAPSi and it will be a tool to support the activities of operators. Now we are testing the SG with users in collaboration with some schools.

¹³ Wehman, P., Brooke, V., Brooke, A.M., Ham, W., Schall, C., McDonough, J., Lau, S., Seward, H., Avellone, L., 2016. Employment for adults with autism spectrum disorders: A retrospective review of a customized employment approach. In «Research in Developmental Disabilities, vol. 53-54, pp. 61-72.

¹⁴ Hassan, A.Z., Zahed, B.T., Zohora, F.T., Moosa, J.M., Salam, T., Rahman, Md.M., Ferdous, S.H., Ahmed, S.I., 2011. Developing the Concept of Money by Interactive Computer Games for Autistic Children. In IEEE International Symposium on Multimedia, pp. 559-564.

¹⁵ Uzuegbunam, N., Wong, W.H., Cheung, S.S., 2015. MEBook: Kinect-Based Self-Modeling Intervention for Children with Autism. In IEE International Conference Multimedia Expo, pp. 16.

¹⁶ Morris, R.R., Kirschbaum, C.R., Picard, R.W., 2010. Broadening accessibility through special interests: a new approach for software customization. In Proceedings of the 12th ACM SIGACCESS International Conference on Computers and Accessibility, NEW YORK, NY, USA, pp. 171-178.

- Discrete event simulation to analyse the health processes.

Products

Publications

1. Vallefucoco E., Pepino A. and Bravaccio C. (2017), *Strumenti di immersive simulation rivolti a persone con Disturbi dello Spettro Autistico. Modellazione 3D di scenari interattivi*, «Autismo e disturbi dello sviluppo», vol. 15, n. 2, pp. 223-252, doi: 10.14605/AUT1521705.
2. Vallefucoco E., Bravaccio C. and Pepino A. (2017), *Serious Games in Autism Spectrum Disorder: An example of personalised design*. Proceedings of the 9th International Conference on Computer Supported Education, vol. 1, pp. 567-572.
3. Pepino A., Vallefucoco E., Cuccaro P. and D'Onofrio G. (2018), *Simulation model for analysis and management of the no-show in outpatient clinic*. Proceedings of the 10th International Conference on Computer Modeling and Simulation.

Conferences and Seminars

I attended the following conferences:

1. **Progetti in rete sul territorio. Strumenti e Strategie per l'inclusione scolastica in bambini con Bisogni Comunicativi Complessi o con diagnosi di Disturbi Specifici dell'Apprendimento.**
23 March 2017
Centro per la Formazione, via Campana 268, Pozzuoli (NA).
2. **9th International Conference on Computer Supported Education (CSEDU 2017)**
Porto, Portugal, 21-23 April, 2017.
1 paper with oral presentation.
3. **Intervento multimodale precoce per bambini con Disturbo dello spettro autistico Implementazione del Modello Italiano.**
Napoli, 27 November 2017
Aula Magna Scuola di Medicina, University of Naples "Federico II"
4. **10th International Conference on Computer Modeling and Simulation**
Sydney, Australia, 8-10 January 2018.
1 paper with oral presentation.

During this year, I made the following presentations:

1. **Serious Games in Autism Spectrum Disorder: An example of personalised design** in 9th International Conference on Computer Supported Education, 22 April 2017, Porto.
2. **I Serious Game nel progetto riabilitativo: applicazioni nel campo dei Disturbi dello Spettro Autistico** in Disability Pride, 7 July 2017, Napoli.
3. **La personalizzazione dei comunicatori basati sul software Grid 3** in Workshop: "La personalizzazione di Ausili per la comunicazione", organized by Centre SInAPSi and "Centro Medico Riabilitativo Pompei", 11 July 2017, Napoli.
4. **Le App come Tecnologia Assistiva** in Workshop: " APPrendere con la Tecnologia", organized by Centre SInAPSi and "Centro Medico Riabilitativo Pompei", 28 November 2017, Napoli.
5. **Simulation model for analysis and management of the no-show in outpatient clinic** in 10th International Conference on Computer Modeling and Simulation, 8 January 2018, Sydney.
Award: Best Presentation.

Activity abroad

I do not have carried out any activity abroad in my first PhD year.

Tutorship

Exam assistant to the M.Sc course (Biomedical Engineering) of Sistemi Informativi Sanitari and MSc course of Tecnologie per la Valutazione, l'Assistenza e il Recupero Funzionale.

I am holders of a tutoring grant - A.A. 2017/2018. In this activity, I made 20hours of tutoring for the course of Analisi I.