CURRICULUM VITAE

Gianluca Percoco, PhD

Since 2004 Assistant Professor in Manufacturing Systems at the Department of Mechanical and Industrial Engineering, Politecnico di Bari (www.poliba.it)

2003 PhD in Advanced Production Systems Engineering, thesis : “Reverse Engineering: Genetic Point Cloud Processing and Rapid Prototyping Integration” (exact date of award September 5th 2003)

1997-1999 Researcher at Masmec Researches ltd. (www.masmec.com) in the field of Industrial Automation

1997 Master degree in Mechanical Engineering at the Polytechnic of Bari

Associations

AITEM Italian Association of Manufacturing Processes from 2001

AIM@SHAPE network of excellence Advanced and Innovative Models And Tools for the development of Semantic-based systems for Handling, Acquiring, and Processing knowledge Embedded in multidimensional digital objects from 2005

CIRP Research Affiliate from 2007

CNISM Italian Academic Consortium of Physics Science from 2005

Scientific awards

2007 Best paper award for the paper GALANTUCCI L. M, PERCOCO G., DAL MASO U. "Coded Targets Photogrammetry for 3d Digitization of Human Faces". In: PAULO JORGE BARTOLO ET AL. Advanced Research in Virtual and Rapid Prototyping. (pp. 217-230). ISBN: 9780415416023. LONDON: Taylor & Francis (UNITED KINGDOM) presented at Leiria in Portugal conference VRAP 2007.

2001 Best paper award for the paper “A Genetic Algorithm Approach for the Reduction of Point Clouds of Scanned Complex Shaped Parts” with the co-author Prof. R. Spina at the 12th International DAAAM Symposium, Jena (Germany) from 20th to October 23rd 2001 published on the Proceedings of the “Annals of DAAAM International for 2001 & Proceedings of the 12th International DAAAM Symposium”, ISBN 3-901509-19-4. Published by DAAAM International, 2001, Editor B. Katalinic, pp. 355-356.

Research activity

The scientific activity of the candidate principal investigator has been developed at public and private research institutes. During his university studies, he has been for 4 months visiting student at Ecole

Normale Superioure of Cachan in France working with Dr. Alain Chep and Prof. Pierre Bourdet, on a CAD\CAM interface for CAPP appluications.

From 1997 to 1999 he has participated to the european research project E!Manufuturing “Self-Innovating extended Factory for Electro-mechanical Products” in collaboration with ZANUSSI and ITIA-CNR (Institute of Industrial Technologies and Automation-Italian National Research Council- www.itia.cnr.it) and to the national project “SPI-3” in collaboration with Electrolux and ITIA-CNR. In this phase the research activity has concerned mechatronic systems aimed to the quality control of the performance of air compressors through innovative methodologies regarding acoustic and vibration measures. Thanks to his studies several online automatic test station have been designed and installed at Unidad Hermetica (Electrolux) in Sabadel-Spain and at TRW-Marzocchi at Ferrara-Italy. Both these machines are actually working.

Attending the PhD courses the research work has been focused on several phases of 3D CAD reconstruction from point clouds obtained by different 3D digitizing technologies, finding new solutions and improvements. The study of several 3D NURBS reconstruction methodologies has been conducted comparing the classical methodology of reconstruction, through curves, to the rapid methodology, through polygonization, highlighting advantages and disadvantages of commercial solutions and proposing a new hybrid method based on sectioning the polygonized surfaces through curves, exploiting the advantages of both methods. As regards point cloud elaboration methods, the research work has been focused on the use of artificial intelligence techniques, such as neural networks and genetic algorithms.

Recent Research Projects:

2007 Principal investigator of: “Analysis and Realization of a Microfluidic Prototype for Biomedical Applications” funded by Masmec, amount euro euros.

2006 Principal Investigator of: “Development of a prototype of an antropometric chamber for 3D scanning of the human body using digital close range photogrammetry for custom made garments”, funded by Apulian Regional Government, amount 90.300 euros.

2007-2009: “Reverse Engineering for the non-invasive diagnostics in Orthodontics and Dentofacial Orthopedics: development of a system for automatic measurement of faces, based on photogrammetry”, PRIN 2007 funded by Italian Ministry of Research Principal Investigator: Prof. Ing. Luigi M. Galantucci, amount 71500 euros.

2006 Hybrid Moulds for direct injection moulding for the shoe industry, funded by Apulian Regional Government, amount 92.300,00 euros. – Principal Investigator: Prof. Ing. Luigi M. Galantucci.

Papers are available dealing with point cloud alignment with a neuro-genetic approach and genetic algorithms. The use of these artificial intelligence tools has proved to be very promising in this phase of the Reverse Engineering (RE) process. The task connected to the search for the shape recognition and subsequent correct orientation of point clouds was successful, despite the high complexity of the parts

used in the case studies, as demonstrated by the failure of two commercial available software packages to align the clouds. GA was independent of the initial position, but the use of the initial ANN (Artificial Neural Network) shape recognition phase significantly reduced the search space and contributed to speeding-up the GA (Genetic Algorithms) in terms of lower number of generations needed to identify the optimal solution. Moreover, prior information on correspondence or feature points was not necessary. The genetic operators have proved to be very useful for the applications considered, thanks to their capability of overcoming local minima.

Other topics such as point clouds tessellation with volumetric methods, and segmentation have been explored. As regards tessellation using volumetric methods, starting from a point cloud the approach proposed is able to detect, through voxelization, the surface shape at a logical level. The use of this approach allows automatic creation of good quality meshes, preserving sharp edges, and reconstructing complex topology meshes, minimizing reconstructed surfaces errors. With regard to segmentation, a multilevel methodology has been implemented using object oriented programming embedded in a commercial CAD software package. The approach proves to be more efficient than state of the art methodologies as regards the following aspects: optimization of the elaboration time thanks to automatic edge detection on the raw model and the ability to merge the points of a single contour into one ordered set, which permits the construction of an edge curve. Moreover, the approach is general purpose and to detect smooth edges as well as sharp edges.

The analyses of 3d scanning systems has dealt with laser and photogrammetric systems, comparing the technologies, performing experimental studies on the accuracy of digital close range photogrammetry with Design of Experiments and with biometrical photogrammetry applications. As regards the accuracy of photogrammetry, the experimental study conducted demonstrated that the relevance of a factor depends on the complexity of the object and the kind of geometric measure. In fact, when complex objects with a high curvature are considered, the number of photographs becomes a very important factor. In this way, the shape of the object is better described if it is captured from different positions. Instead, if the object has a simple shape or if only a linear distance has to be measured, the number of photographs does not affect the result. The research on photogrammetric 3d scanning systems has been developed in collaboration with Dr. Rosalinda Ferrandes at the Laboratoire Sols Solids, Structures of the Grenoble Institute of Technology.

Integration between Reverse Engineering and Rapid Prototyping.

Reverse Engineering (RE) is a crucial technology because it can encode real objects with digital data. On the other hand, Layered Manufacturing (LM) and Rapid Prototyping (RP) techniques represent the links that can work back from digital data to the real world.

If a direct and quick fabrication of the 3D scanned part is needed, the tessellated STL file represents the de-facto standard for the data exchange. The improvement of mesh computation methods has been already described in the previous paragraph.

Moreover a UML framework has been proposed to create prototypes starting from real products. The use of this system have led to several advantages such as the reduction of the time-expensive operations connected to information exchange necessary to reproduce an existing part via Tele-Engineering and the creation of a wellstructured framework to efficiently coordinate tasks of several virtual enterprise units.

In this context multidisciplinary papers have been written in conjunction with radiologists and medico-legal researchers of the University of Bari, regarding the application of several scanning methodologies for the replication of a human skull with the FDM process for the subsequent reconstruction of facial muscles for identification purposes.