CRS4 Visual Computing

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Abstract

This lab presentation briefly describes the Visual Computing group of the CRS4 research center. Established in 1996, the group primarily focuses on the study, development, and application of technology for acquisition, storage, processing, distribution, and interactive exploration of complex objects and environments. Research is widely published in major journals and conferences, and many of the developed technologies are used (or have been used) in as diverse real-world applications as internet geoviewing, scientific data analysis, surgical training, and cultural heritage study and valorization.

1. Introduction

CRS4 is a leading Italian research center focusing on state-of-the-art computational technologies and on their application to problems stemming from a variety of domains, including biomedicine, information society, energy and environment, and cultural heritage. The center was established in 1990 and has a current staff of about 160 people (including permanent and non-permanent positions).

Enrico Gobbetti joined CRS4 in 1996, where he established, and, since then, directed the research program in Visual Computing, which has gradually become one of the leading Italian research programs working in this field. Research activities span many areas of visual and geometric computing, the primary focus being the study and development of scalable technology for acquiring, creating, distributing and exploring complex objects, as well as for integrating them in real-time interactive visual simulations and virtual environments, both in local and distributed settings. Recent research achievements include, for instance, novel solutions for: effectively combining acquired colorimetric and geometric information; processing, rendering and streaming terrains, urban environments, massive 3D meshes and point clouds; compression-domain rendering of massive scalar volumes; exploration of massive and annotated data on large scale installation settings, web, and mobile devices;

interactive surface and volume visualization on novel light field displays.

2. Staff

Current members are the following: Enrico Gobbetti (Director); Marco Agus (currently on leave at KAUST), Fabio Bettio, Alberto Jaspe Villanueva, Fabio Marton, Ruggero Pintus, Giovanni Pintore, and Antonio Zorcolo (RTD staff, including permanent and temporary positions); Katia Brigaglia and Cinzia Sardu (part-time adm. assistants).

3. Facilities

Rooms and locations. CRS4 is located in the POLARIS Science and Technology Park, about 40Km West of Cagliari, Sardinia, Italy. As part of a recent agreement with the Municipality of Cagliari, a secondary Visual Computing lab has been set up in the "Ex Distilleria" location, which is downtown Cagliari.

Equipments and platforms. The group has advanced facilities, many of them acquired and supported through extramural funds, that are used for research and technology transfer activities. Dedicated computational and network resources, which include high speed networks and hybrid GPU/CPU clusters, are complemented by state-of-the-art

user interaction and visualization hardware. Acquisition devices include PHANToM force feedback arms, custom camera arrays, long-, medium-, and short-range 3D scanners, custom setups for multi-light acquisition (e.g. RTI), as well as commercial and custom-made 3D trackers used for developing interactive 3D applications. The range of available display devices goes from 3D printers, to high resolution visualization walls and experimental light-field displays delivering fully 3D interactive images to multiple naked-eye observers. In addition, the group regularly works on cultural heritage projects, and a number of large scale interactive installations are currently visible (or have been visible) in Museums and Exhibitions around Italy and abroad (Permanent: Cagliari, Cabras, Sassari; Temporary; Rome, Milan, Zurich). These exhibitions have been visited by tens of thousands of visitors.

4. Collaborations

Funding. CRS4 is a public research organization supported by the regional government. In addition, the activities of the Visual Computing group at CRS4 are heavily supported through extramural funding. Since its establishment in 1996, the group secured in excess of 9M € of external funding. Of these, about 4.7M € are from international grants (mostly EU projects), about 0.8M € from services and industrial collaborations (mostly from technology transfer activities related to terrain rendering, surgical simulation, point cloud management and cultural heritage valorization), while the rest are from national or regional research grants.

Important recent industrial partners. Many of the enabling technologies developed by the group have been used in as diverse real-world applications as cultural heritage computing, Internet geoviewing, visual simulations, scientific data analysis, and surgical training. Stable industrial partners include Gexcel (Italy), Holografika (Hungary), and Diginext (France). Technology transfer activites also target the public sector (Italian regional geoviewing system, cultural heritage applications).

Important recent public and academic partners. Many of the research activities are carried out in the framework of international collaborations. Current important academic partners include Yale U., UPC Barcelona, ISTI-CNR, U. Zurich, U. Verona, and KAUST. Moreover, the group frequently collaborates with public institutions. In particular, strong links are established with the Region of Sardinia and the Municipality of Cagliari for Urban Computing, and with various institutions in the cultural heritage domains (e.g., Sardinian Archaeological Superintendences and Museums). In addition, the group's members are active in the Eurographics community (current EG Italian Chapter EXC members, organization and/or chairing of Eurographics 2012, EGPGV 2012, EGPGV 2013, EuroVis 2015, EGPGV 2015, EGPGV 2016, STAG 2016).

5. Projects

Right now, it's only a notion. But I think I can get money to make it into a concept. And later turn it into an idea. (Woody Allen, Annie Hall, 1977).

Well, we even get funding to implement our ideas... Currently active externally funded projects are the following:

- *Scan4Reco: Multimodal Scanning of Cultural Heritage Assets for their multilayered digitization and preventive conservation via spatiotemporal 4D Reconstruction and 3D Printing.* Funded by EU H2020 under grant H2020-REFLECTIVE-7-2014 665091 (start: 2015/10, duration: 36 months). Novel methods for multi-spectral photometric acquisition.
- *VASCO: A Virtual Studio for Security Concepts and Operations.* Funded by EU Seventh Framework Program under grant 607737 (start: 2014/03, duration: 36 months). Capture of structured indoor environments using mobile devices.
- *MONTEPRAMA4: 3D digitization and exploration of Mont'e Prama Statues.* Funded by MIBAC/ArcheoSAR under contract ARCHEOSAR/CRS4 CIPE-93/2012. Capture, reconstruction, and display of statues.

6. Future of the lab

Prediction is very difficult, especially about the future (Niels Bohr et al.), even though it's easy to guess that *in the long run we are all dead* (John Maynard Keynes). In the meantime, we'll work on enabling technologies for creating and exploring massive and complex datasets. The major focus will be on spatial data and data embedded in 3D space, which have a strong impact in a wide range of application domains.

7. Selected recent publications

Our research is widely published in major journals and conferences. Five selected publications for (the beginning of) year 2016 are listed as references.

References

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