Proposition de recherche doctorale

3D Copy-Paste: Cross Parameterization of 3D Data

Mots clés :
- Directeur de thèse : Florent DUPONT
- Co-encadrant(s) :
- Unité de recherche : Laboratoire Traitement et Communication de l'Information
- Ecole doctorale : École Doctorale Informatique, Télécommunications, Électronique de Paris
- Domaine scientifique principal : Divers

Résumé du projet de recherche (Langue 1)

WEB: http://perso.telecom-paristech.fr/~tierny/stuff/openPositions/phdPosition2014.html With the recent significant developments of 3D displays, graphical processing units, and web-based 3D technologies, the entertainment industry related to computer graphics (gaming, motion pictures, etc.) has to deal with an important increase of activity. However, the most resource-consuming task in this field is not the production of the software generating the virtual worlds, but the production of the 3D data populating these virtual worlds (characters, buildings, vehicles, etc.) In addition to the creation of the geometry of a 3D virtual object, a designer has to create a large number of additional geometrical structures, that we call "geometrical meta-data", which will enrich the visual appearance of the object, including: · Texture atlases: which consists of a set of 2D pictures "glued" onto the boundary surface of the 3D object (see Figure 1); · Bump maps: which consists of sets of specifically designed bumps that will create some roughness on top of the object; · An animation skeleton: which consists of a symbolic skeleton located inside the object, that will help animate the object; · A deformation cage: an alternative to animation skeleton, which consists in a low resolution surface enclosing a 3D object (by moving the few control points of the cage, the enclosed 3D object is automatically smoothly deformed, see Figure 2); · Volumetric textures: which will define the color of the inside of semi-transparent objects; · etc. Although these geometrical meta-data can be very similar from one object to the other, designers still need to re-create them nearly from scratch every time a new object is designed. With this Ph.D. thesis, we would like to address this issue by developing a new system for the interactive Copy-Paste of Geometrical Meta-Data, where the designer would select the meta-data of an existing object and the system would automatically deform and fit them to another, newly created, object (as illustrated in Figure 3).

Résumé du projet de recherche (Langue 2)

In order to transfer the geometrical meta-data from one object to another, one needs to address the scientific problem called "Cross Parameterization", which consists in: · Generating automatically a continuous and exhaustive point-to-point correspondence between two objects; · While guaranteeing a minimal amount of distortion (localized deformation); · While satisfying some user defined constraints. This problem has been intensively researched over the last few years (with user-driven [KSK98], [Alex99], [KS04], [SAP04] and automatic approaches [LF09], [KLF11], [TDN11]) and starts to be well understood, but only for the boundary of the 3D objects, not for their interior. For instance, Tierny et al. introduced a fast and automatic surface cross parameterization algorithm [TDN11] which was used to copy-paste geometrical meta-data (here quadrangular meshes) from the boundary of a 3D object to the boundary of another (see Figure 4). In order to take into account volumetric meta-data (volumetric textures, animation skeleton, deformation cages), one needs not only to compute a point-to-point correspondence between the boundaries of the objects but also between their embedding 3D space (interior and exterior). This later problem is called Volume Cross Parameterization, as opposed to Surface Cross Parameterization. While the surface cross parameterization problem starts to be understood by the community, there is currently only little published results, still describing in a preliminary manner the volumetric case [PPL13]. With this Ph.D. thesis, we would like to develop efficient algorithms for the cross parameterization of volumes, first in a user-driven manner (with sparse control points), then in a fully automatic manner. This overall scientific topic opens many interesting and unresolved problems such as: · Performance driven cross parameterization (how to compute a satisfactory result given a fixed time and/or memory budget); · Volume cross parameterization from degenerated data, or how to compute a cross parameterization with only a low quality (ie non-manifold) boundary-only representation of the 3D objects; · Partial volume cross parameterization (how to compute a point-to-point correspondence between only sub-parts of 3D objects); · etc.

Informations complémentaires (Langue 1)
The student will have the opportunity to interact with the advisers' international collaborators.

Informations complémentaires (Langue 2)