PhD position

Mesh simplification with structure control

Context
Recent evolutions in Multiview Stereo allow practitioners to measure urban environments at resolutions that were until now possible only at the scale of individual shapes [1,2]. The related scientific challenge is now to transform massive and dense meshes into more compact representations that are structure-aware [3]. Structure is a generic term that refers here to the way the individual shapes are grouped to form objects, object classes or hierarchies. In an urban context, exploring the structure can correspond to the modelling of objects at different Levels Of Detail (LOD), see Fig. 1. This objective can be realized through complex reconstruction algorithms, eg [4], or, more directly, by surface approximation. Surface approximation is a traditional research topic which consists in simplifying the input surface of an object or a collection of objects given some quality measures, eg faithfulness and compactness. The geometry processing community has deeply explored this topic by considering defect-free meshes as input data [5]. However, this topic has been poorly explored from real world meshes, and no efficient solution has been proposed so far from meshes generated from Multiview Stereo.

Objectives
Existing methods, eg [6], typically allow the preservation of the object structure at a given scale, but fails to bring control upon the structure in order to explore the scale spaces of the structure. The aim is to develop a methodological framework to create generic 3D models from unorganized parametric shapes, eg planes, which enable to explore the scale-space of an object or an observed scene while conforming to a given LOD formalism. Contrary to traditional simplification frameworks, the proposed
should rely on a global approach in which geometric and semantic regularities at the city scale must be taken into account. Among the difficult questions to solve, the candidate will investigate on how to produce 3D models with geometric and topological guarantees that conform to a given LOD formalism, and also on how to manage the missing data and heterogeneous sampling. In particular what type of knowledge can we consider when geometric descriptors are insufficient, and how to model it?

**Keywords**
Computer vision, geometry processing, urban scenes, surface approximation, 3D modeling.

**Candidate profile**
The ideal candidate should have good knowledge in computer vision, 3D geometry and applied mathematics, be able to program in C/C++, be fluent in English, and be creative and rigorous.

**Location**
INRIA, Sophia Antipolis Méditerranée, (near Antibes on the Côte d’Azur, France), within the TITANE research team (https://team.inria.fr/titane/)

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**References**