make maps more natural; Hoarau et al. (2013; 2015) provide rendering techniques based on color, transparency and natural and procedural textures to co-visualize vector data and ortho-photographies. Raposo & Brewer (2011; 2013) compare topographic map designs using orthoimage backgrounds in order to identify preferred design methods and propose a symbol specification suitable to swing from map to ortho-image. Several research works use orthophotographies as realist information sources for realist characteristics retrieval and application in realist representations (CROMBEZ et al., 2013; LAFARGE et al., 2010).

A high level of photorealism and high level of detail have been the main challenge for 3D rendering, in order to obtain high visualization quality (DRETTAKIS et al., 2007). An opposite view is to consider that photorealism techniques do not offer optimal solutions for understandable visualizations, e.g. too low contrasts, visual noise, imprecise objects boundaries, etc. (SEMMO et al., 2010). Kostelnick & McDermott (2011) evaluate the relevancy to use photorealism (photos or virtual reality in 3D) to represent risks according their dangerousness. Zanola et al. (2009) aim at determining the influence of realism level in 3D representations on the confidence in data quality a user may have. Expressive rendering allow stylizing 3D models in order to attempt aesthetic purposes or more efficient renderings (DÖLLNER, 2007; WILLATS & DURAND 2010; CUNZI, et al 2003, etc.) and thus to inject some semantical, geometrical and graphical abstractions. Döllner *et al.* (2006) identify three relevant styles to render a 3D urban model (photorealist, informative and illustrative), integrated by (SEMMO *et al.*, 2012) in a continuum of representations.

Semmo *et al.* (2012) also propose to use parametrization of rendering methods to make progressive transitions between various levels of abstraction and various strategies to distribute the level of abstraction in the representation according to the distance from the image center or the saliency of rendered objects. Hoarau et al. (2015) propose various symbol specification methods to interpolate colors and textures between orthoimagery and vector data (vector & raster styles mixing). Style mixing has been also used to manipulate several styles of 3D models (TALTON et al., 2012) or websites (KUMAR et al, 2013).

**2.3 Features**

We consider that the substantial knowledge base we benefit for 2D representations could be transferred to 3D representations. Formally, models of style and legend have been provided for 2D representations, but not considered through the 3D perspective. Parametrization of rendering engines for 3D representations have not been formalized as styles relying on graphic parameters, useful to control the resulting renderings. Figure 1 specifies these relations between concepts: a *Style* is composed by assignments of values of *Graphic Parameters* to *Named Feature*; the *Rendering Engine* uses the specification of a *Style* to render the related *Geographic Features*.

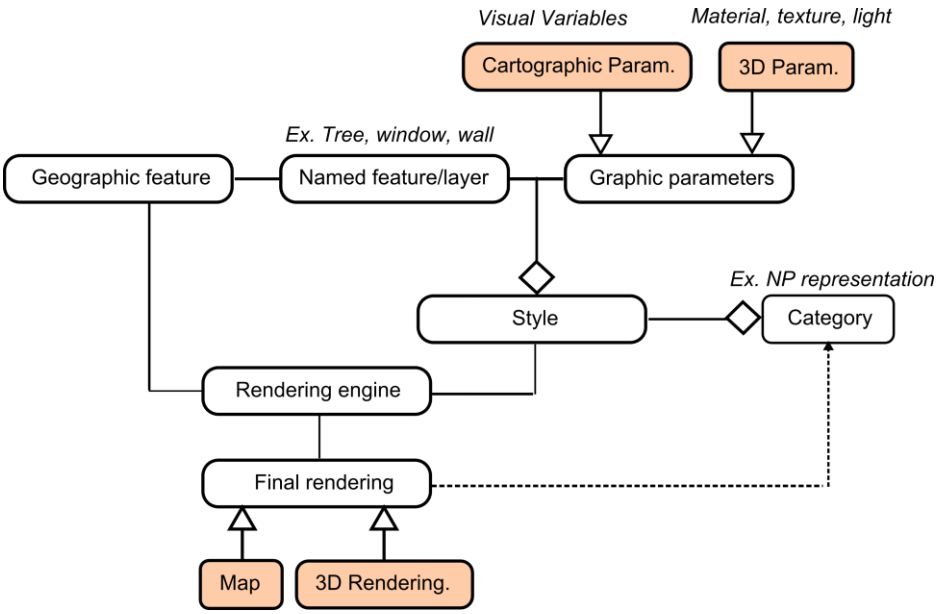


Fig. 1 - Modeling of the notion of style as rendering parameterization.

We thus address the issue of being able to define and specify visual variables for 3D, such as visual variables and related properties we have for 2D: those so-called *Graphic Parameters* could be used to make various styles, specifying the rendering methods to use. The aim of this article is to present our current advances and agenda about the specification of 3D styles in the context of 3D rendering. This is a preliminary work of ongoing researches. A first step is to be able to propose *Categories* of *Styles*, and typical values for the related set of *Graphic Parameters* (see Figure 1).

The section 3 describes our global approach. In section 4, we present our future work and research agenda about 3D styles and the opportunity to provide 3D semiotics framework.

## 3. GLOBAL APPROACH

In section 3.1, we propose and apply a method based on the study of 3D renderings of urban projects, in order to produce a knowledge base that describes the styles. From this base of knowledge, we propose several style categories and extract typical graphic parameters (section 3.2). In order to illustrate our work, we propose to study two classes of categories according to the level of photorealism and the level of detail. An immediate use of this base of knowledge is presented in section 3.3 and aims to mix two different styles in order to provide continuous transitions between them.

### 3.1 Evaluation of a set of existing styles

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