Research paper

Testing the validity of a saliency-based method for visual assessment of constructions in the landscape

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ABSTRACT

This paper aims at evaluating a method for objective visual assessment of constructions in the landscape based on saliency, which is defined as the distinct perceptual quality by which an item in the world stands out from its surroundings and therefore attracts attention (conspicuity). Photographic simulations of public facility buildings, water towers and transmission towers inserted in a rural environment are created in different designs, colours and sizes. Their corresponding saliency maps, which are computationally generated predictions of the human viewing pattern, are calculated and compared with the saliency map of the original landscape photograph through a correlation analysis. Higher correlations indicate a smaller visual contrast from a landscape point of view of minimizing the visual disturbance. The method can also be used to generate eye-catching designs such as landmarks. The output of the saliency method is compared to human assessments of visual integration obtained using a photo-questionnaire. The results demonstrate that the saliency method is sensitive to differences in colour and size. In addition, the outcome is consistent with people's subjective assessments. For design differences, this is less the case, probably because more factors than just the visual aspect are involved when choosing a design. The method could thus be useful when scenarios only differing in size and colour are to be compared. It is fast and easy which allows the assessment of many different scenarios and viewpoints. This could be valuable for designing more effective and all-round visual impact mitigation measures integrated in the design of a construction.

1. Introduction

Within society there is a growing awareness of the importance of landscape quality (Tassinari, Torreggiani, Paolinelli, & Benni, 2007). This quality is determined by different aspects comprising nature conservation values, agricultural and forestry values, water resources, cultural heritage, residential values and visual quality (Wu, Bishop, Hossain, & Špíso, 2006). This latter aspect is to a high degree controlled by human intervention in the landscape, which can greatly affect or even alter its visual quality. The architecture of new constructions plays an important role in determining the landscape’s visual quality. Harmonious designs of diversity and uniqueness which take into account the historical significance and landscape character of a region are desired (Tassinari et al., 2007). When designed and built in harmony with the surrounding landscape, particularly remote rural buildings can be used as a means of enhancing the visual quality of the landscape (Mérdida-Rodríguez and Lobón-Martín, 2011). According to Mérdida-Rodríguez and Lobón-Martín (2011), landscape integration is described as ‘making something become part of a whole’. As such, integration entails the adaptation of an object or territorial action to the physiognomic characteristics of the landscape or to some of its components used as a reference. Integration is more than the visual aspect as it also comprises the establishment of relationships between objects and human interpretations in terms of function, meaning etc. In this paper, we will focus on visual landscape integration as how well an object visually fits into the landscape as a function of its size, colour, design, materials used and visual relationship with other objects in the landscape. For assessing this visual integration, however, clear, standardized and uniform methods and procedures are not well established yet (Fabrizio and Garnero, 2012; Lange, 1994; Minelli et al., 2014; Palmer, 2015; Tassinari et al., 2007; Uzzell and Jones, 2000) as a consequence of the lack of solid theoretical approaches of the topic (Mérdida-Rodríguez and Lobón-Martín, 2011).

In this respect, research has been conducted to assess the visual impact of a construction in terms of its visibility by mapping the area in which the construction will be visible (e.g. Burrough, 1994; Fisher, 1996; Hernández, García, & Ayuga, 2004; Minelli et al., 2014; Möller, 2006; Nijhuis, Van Lammeren, & Van der Hoeven, 2011; Rogge,
This is often carried out in GIS by performing a viewshed analysis to determine the most suitable location for the development of the new construction, i.e. the location with the lowest visibility (smallest viewshed) (Bishop, 2003). However, such assessments do not take into account the visual characteristics of the construction in terms of lay-out and design, and can therefore not be used to evaluate the visual integration in the surrounding landscape. This kind of visual integration has not been extensively investigated within the field of science. Studies concerning visual integration in an urban environment are very scarce (e.g. Sumper, Boix-Aragonés, Villañafilla-Robles, Bergas-Jané, & Ramírez-Pisco, 2010; Unver and Ozturk, 2002).

In rural landscapes, visual integration research has mainly focused on visual impact mitigation of agro-industrial buildings (e.g. Di Fazio, 1989; García, Hernández, & Ayuga, 2003; García, Hernández, & Ayuga, 2006; García-Moruno, Montero-Parejo, Hernández-Blanco, & López-Casares, 2010; Hernández et al., 2004), greenhouses (e.g. Rogge et al., 2008) and renewable energy infrastructures such as wind-power plants (e.g. Ladenburg, 2009; Minelli et al., 2014; Palmer, 2015) and photovoltaic plants (e.g. Chiabrando, Fabrizio, & Garnero, 2011; Minelli et al., 2014; United States Department of the Interior, 2013) but far less on other infrastructural buildings (e.g. transmission towers, water towers, public facility buildings etc.) (e.g. Tassinari et al., 2007). For large-scale infrastructural projects such as industrial buildings, railways, dams, quarries, high voltage lines etc., Directive 2001/42/EG of the European Parliament and the Council of 27 June 2001 obliges an environmental impact study. However, this study does not provide clear guidelines nor assessment procedures and certainly not for visual impact assessment (Dalal-Clayton and Sadler, 2005). For smaller-scale building projects, an environmental impact study is not even compulsory. As a consequence, procedures and instructions for visual impact assessments in spatial planning in most European countries in the dimension, colour and design of an inserted construction varies. The inserted constructions are infrastructural constructions such as non-residential, public buildings, water towers and transmission towers, which are often experienced as disturbing. The comparison of the results found for the different simulations of the same construction allows us to determine whether the method is sensitive to these different scenarios. In addition, the results are compared to human judgements of the visual integration of the simulated constructions in order to examine if added visual contrast increases the experienced visual impact.

2. Methods

2.1. Creation of the simulations

2.1.1. Photographic stimuli

Ten landscape photographs were taken in rural areas in Belgium. To obtain comparable images, the same routine was repeated when taking the photographs. The images were all taken with a Canon EOS 1000D camera using a focal length of 50 mm to assure that equal visual angles were obtained. Furthermore, a tripod was used to achieve a constant camera height of 1.70 m. The horizon was always placed in order to generate pictures with a composition of 2/3 of land and 1/3 of sky. The represented landscapes are rural areas in Flanders (Belgium) where traditional building styles have become rare and have been replaced by modern buildings with a contemporary, miscellaneous architecture. Buildings are generally clustered in villages, but remote buildings also occur.

2.1.2. Simulations

For each landscape photograph, simulations were created in GIMP, a free-access photo-editing software package. An object that could either be a water tower, a public facility building or a transmission tower was inserted into the image. For each object, three different designs were simulated as realistically as possible. The illumination conditions of the inserted element were geared to the conditions in the original photographs and shadows were added where necessary. This procedure generated 30 simulations in total: in four landscapes a public facility building was inserted, in three a water tower and in three a transmission tower.

In a second step, two additional simulations, in which the size of the object was varied, were created for each of the 30 simulations. Variation in size was chosen as this variable has been identified as essential in determining the visual impact of a construction (Curado and Marques, 2012; Mérida-Rodríguez and Lobón-Martin, 2011). More specifically, a smaller and a bigger version of the object was inserted...
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