

Pattern, cognition and spatial information processing

Representations of the spatial layout of architectural design with spatial-semantic analytics

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Abstract. In this paper, we review and extend the idea of Alexander’s “pattern language”, especially from the viewpoints of complexity theories, information systems, and human-computer interaction, to explore spatial cognition-based design representations for “intelligent and adaptive/interactive environment” in architecture and urban planning. We propose a theoretic framework of design patterns “with spatial information processing”, and attempt to incorporate state-of-the-art computational methods of information visualization/visual analytics into the conventional CAAD approaches. Focused on the spatial-semantic analytics, together with abstract syntactic pattern representation, by using “spatial-semantic aware” graph grammar formalization, i.e., Spatial Graph Grammars (SGG), the relevant models, algorithms and tool are proposed. We testify our theoretic framework and computational tool *VEGGIE (a Visual Environment of Graph Grammar Induction Engineering)* by using actual architectural design works (spatial layout exemplars of a small office building and the three house projects by Frank Lloyd Wright) as study cases, so as to demonstrate our proposed approach for practical applications. The results are discussed and further research is suggested.

Keywords: Pattern language, complex adaptive systems, spatial cognition, design representations, spatial information processing, Artificial Intelligence, visual language, Spatial Graph Grammars (SGG), spatial-semantic analytics.