On the Use of Occlusion Maps to Examine Additions to Existing Buildings

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ABSTRACT

This paper discusses occlusion maps, or diagrams of isovists deployed in a plan field, which graphically describe an inhabitant's position-dependent perception of a building's visual permeability. Occlusion maps are shown here to be an important tool for analyzing the effect that additions to existing buildings have on this perception. The question is critical because additions invariably affect the visual permeability of their host buildings.

1 ISOVISTS WITHIN AN ENVIRONMENT

When an existing building is entered and inhabited, views of the exterior from the interior are never total: the building works like a mask or filter, selectively occluding its surroundings from its inhabitants' view. If an addition is made to an existing building, the functioning of this occlusion changes in specific ways, as old views are blocked and new ones are opened. To precisely examine how the visual permeability of architecture changes in such a situation requires comparative tools, which explicitly register the field properties of visual perception.

The isovist was proposed by architect Michael Benedikt as the set of all points in an environment visible from a fixed station point (Benedikt 1979), similar to Porter's spatial boundary diagram (Porter 1979). Benedikt and subsequent researchers with an interest in measuring and mapping the properties of sets of isovists (e.g., Turner and Penn 1999; Batty 2001; Turner et al. 2001) have tended to avoid illustrating isovists deployed throughout an environment in favor of illustrating the properties derived from isovist fields. Though, there exist significant exceptions to this general approach (e.g., Hanson 1994), as well as new investigations into three-dimensionality (e.g., Culagovski 2007).

This paper explores the possibility of mapping isovists deployed within an environment and identifying the potentials this mapping has for the study of additions to existing buildings. To develop this possibility, the author devised a simple AutoLISP routine (VISMAP) for preparing plan isovists. Given a floor plan drawn in a single layer, VISMAP accepts user input for grid extents and intervals, and input for the radius of an arbitrary "horizon circle." Then, for each station point in the grid, VISMAP constructs an isovist using a procedure similar to Dr. Michael Batty's description of an agent "walking" within an environment (Batty 2001). This process is repeated for each station point. Figure 1 depicts the operation of VISMAP.

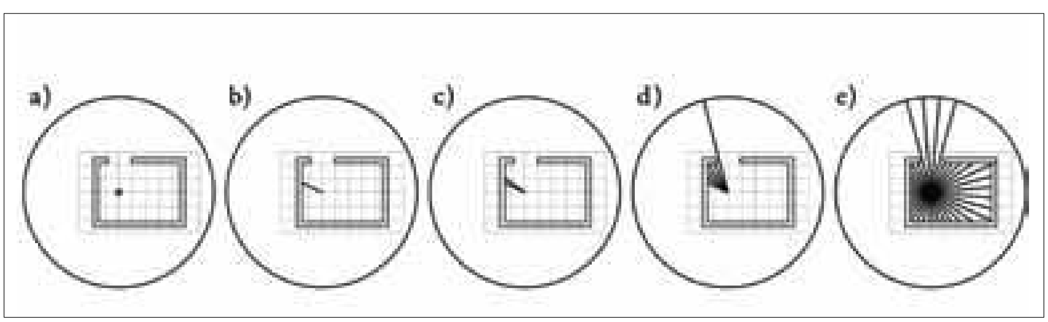

Figure 1 Operation of VISMAP

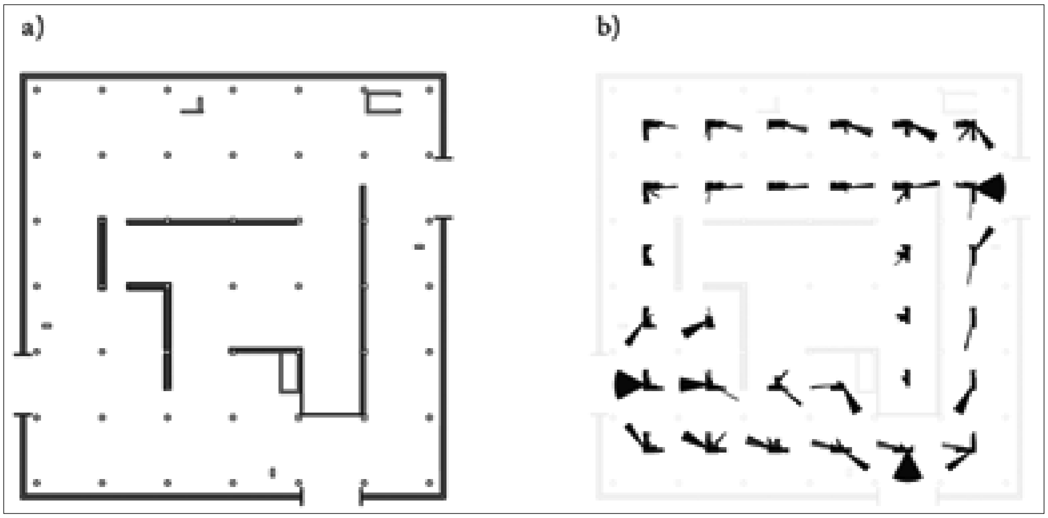

Figure 2 VISMAP at the National Museum of Western Art, Tokyo

Figure 2 shows the result of running VISMAP on an AutoCAD drawing of the main gallery floor of Le Corbusier's National Museum of Western Art (NMWA) in Tokyo. Figure 2a shows the AutoCAD drawing prior to VISMAP execution; figure 2b shows the result of VISMAP with the original AutoCAD drawing, displayed in grayscale for clarity.

Figure 2b records the effect that an observer's position in space has on his perception of the building's visual permeability. This diagram is termed an occlusion map. Varying the intervals of the VISMAP grid alters the degree to which the occlusion map registers slight changes in observer position (fig. 3).

Each of the maps in figure 3 reveals the building's characteristic structure of visual permeability, disposed as a square spiral. That this structure is visible over varying grid intervals suggests that minimizing the grid interval, or setting the grid with reference to "human scale," may not be a prerequisite for disclosing important information about the environment. This counters prior research on the necessity or desirability of doing so (e.g., Turner and Penn 1999; Batty 2001; Turner et al. 2001).

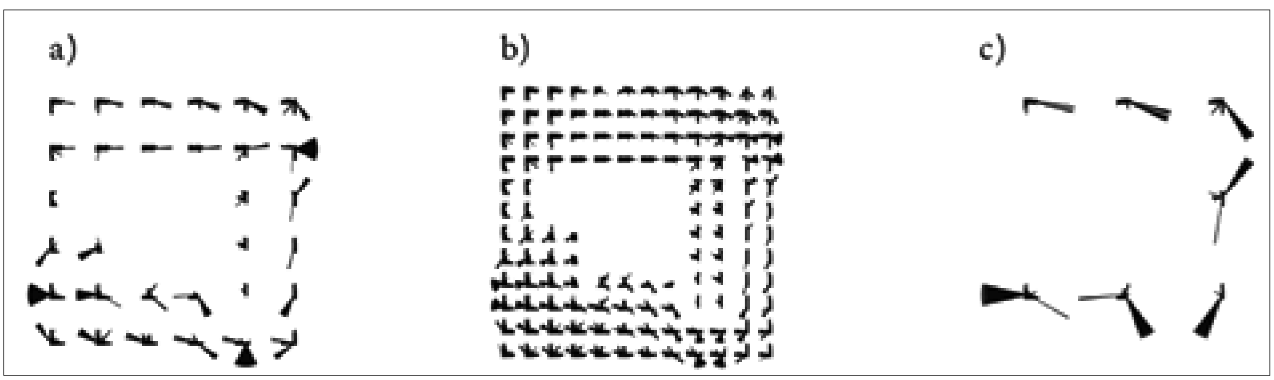

Figure 3 Changes in interval

2 APPLICATIONS

Figure 4 indicates the application of VISMAP to the NMWA both before (fig. 4a) and after (fig. 4b) a major addition was constructed in 1979.

A comparison of figures 4a and 4b confirms that occlusion maps register visual permeability as a property of architecture that changes with the act of addition. This property is characteristic of the environment when considered as a field. Figure

4 demonstrates that the addition affects the perception of visual permeability throughout the field, at its perimeter, as well as at points well within the existing building. Changes to visual permeability are strongest in the area identified with a dashed line. Note how the addition reduces visibility through the window on the right side of the existing building, and how the addition opens a new avenue of visibility at the lower right corner of the existing building. Figure 4 suggests the possibilities of using the occlusion map as a tool for the design of an architectural addition: either as a means of evaluating possible schemes for addition by comparison, or as a target armature for design, as proposed by Benedikt (Benedikt 1979). The

use of the occlusion map in each case demonstrates that the question of whether an addition will expand or reduce visual permeability at a given point in the field is not uniformly predictable. Because the occlusion map registers for the environment as a whole the effect that an observer's position has on his perception of architecture's visual permeability, it is a powerful tool for visualizing exactly the kind of change in perception brought about by the act of addition.

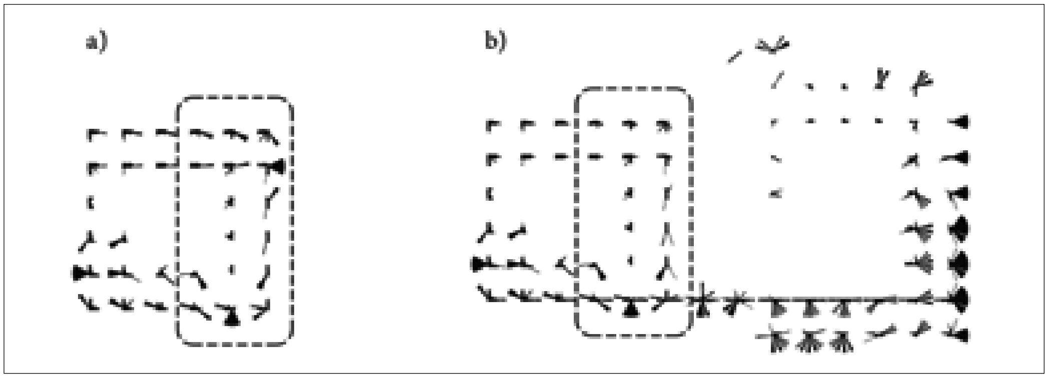

Figure 4 Before/after addition

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