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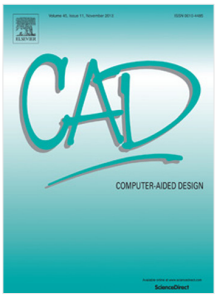

From fractal geometry to architecture: Designing a grid-shell-like structure using the Takagi-Landsberg surface

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Title:

From fractal geometry to architecture: Designing a grid-shell-like structure using the Takagi-Landsberg surface

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Abstract

This paper has applied the concept of fractal geometry in designing a grid-shell-like complex spatial structure. The property of the fractal dimension which characterizes the level of roughness of a shape has been particularly explored in this study for designing a complex-shaped spatial structure by taking a paraboloid as a basic shape of reference. A factor of fractal dimension which is known as the *relative size value* (*w*) plays the key role in changing the surface texture in accordance with the changing of fractal dimension. In this paper, the *relative size value* (*w*) has been specifically applied to study the texture-based shape morphogenesis of a paraboloid by using the reference of the Takagi-Landsberg's fractal surface. This research is curious to see how this surface morphogenesis impacts on the structural behavior and unveils an opportunity to develop a new kind of form. For this purpose, we have computationally generated a parametric model of a grid-shell-like structure by making a paraboloid as a basic geometric framework and by adding an extra supporting frame in order to avoid any structural failure during the surface morphogenesis of the outer profile. A structural comparison has been done in between the grid-shell-like structure having the paraboloid-based smooth outer profile and the structure having a fractal-based unsmooth outer profile. A real-scale physical prototype of a fractal-based grid-shell-like structure has been constructed to see its architectural appearance, real-world structural behavior, practical applicability and constructability.

Keywords: *fractal geometry, grid-shell-like structure, relative size value, midpoint displacements, Takagi-Landsberg surface*

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[2] A part of this research, especially the prototype construction was conducted in the Department of Architecture and Design, Politecnico di Torino, Viale Pier Andrea Mattioli – 39, Turin 10125, Italy.

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