Proceedings of the IASS Annual Symposium 2019 – Structural Membranes 2019
Form and Force
7 – 10 October 2019, Barcelona, Spain
C. Lázaro, K.-U. Bletzinger, E. Oñate (eds.)

Superposed functions as Airy stress functions for form-finding of funicular shell structures

Austin F. DEVIN*, Masaaki MIKI [a], Demi FANG [a], Jonathan BARANOWSKI [a], Jingwen WANG [b], William F. BAKER [a]

*, [a] Skidmore, Owings & Merrill LLP
224 S Michigan Ave, Chicago, IL, USA
[b] Skidmore, Owings & Merrill LLP
14 Wall Street, NY 10005, USA
austin.devin@som.com

Abstract

The design and optimization of funicular compression-only shells can be enabled by Airy stress functions. Previous work discretizes the Airy stress function, which is not often compatible with the nonuniform rational B-spline (NURBS) surfaces that designers typically utilize. A method to superimpose elementary mathematical functions into Airy stress functions to enable improved designer feedback relating to optimization of funicular compression-only shells is presented, determining stress functions directly through elementary mathematical functions [1]. This paper aims to broaden to the design freedom allowed utilizing airy stress functions, thus alleviating the major cited limitation of this approach [2]. A library of mathematical functions is established, wherein each function is assigned a variety of parameters and weights. The superposition of these weighted functions results in a more flexible design space. This paper will describe a procedure to combine superpose mathematical functions into new Airy stress functions for greater diversity of compression-only forms.

Keywords: NURBS surface, Airy stress function, funicular shells, self-supporting surfaces