Parametric Modeling Implementation for Kinetic Systems Simulation: Programmable Matter Matters:

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Abstract

This paper focuses on programmable matter (PM), paying attention to anisotropic material behavior in shape memory alloys (SMA) and its applications within kinetic systems and architecture (KA), using parametric modeling code structures for subsequent architectural application development. Updates were done optimizing and expanding code functionality. Utilizing *agile software development* strategies, we derived new code that expands Grasshopper and Kangaroo's software functionality (SF) concerning digital design and previewing digital fabrication. We evaluated previous and optimized code using code correctness (CC) indicators as defined by Davis (2013) and hereby present its results so that further research and development projects concerning PM and molecular scale material design (MD) can be speculated upon and discussed. These could be used as basis for future research regarding both the theoretical and building application scopes of integrated material design, where simulation is used as a means of quasi-fabrication of kinetic architecture.

* In order to simulate the material's programmed behavior to properly predict critical function, actuation and physical properties, Grasshopper + Kangaroo was used to bridge the design-simulation tool's workflow in a single stream and to optimize and protocolize a smoother and more fluent decision making process.

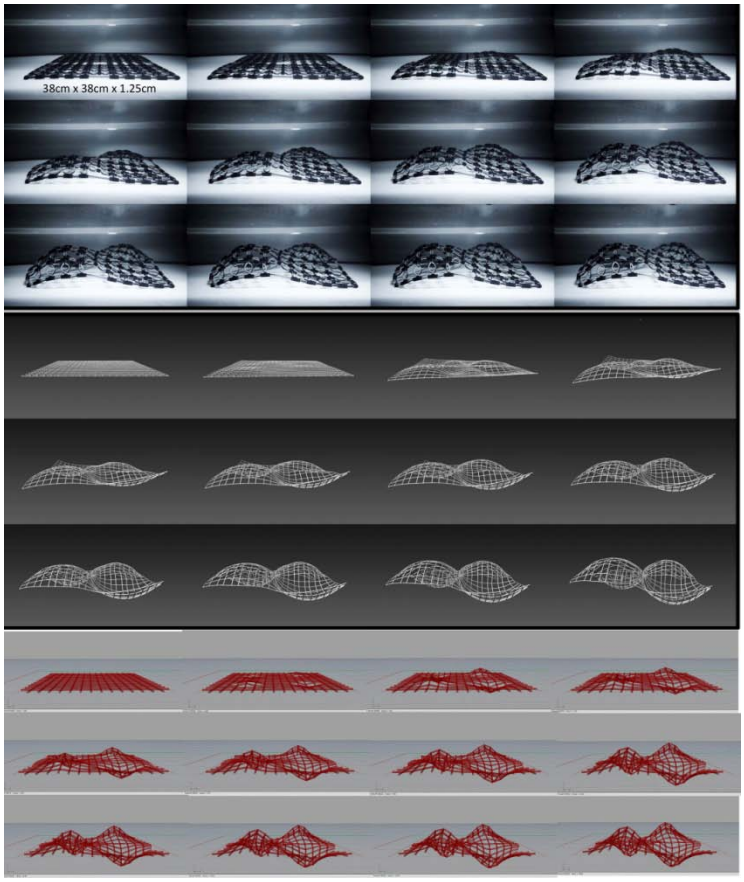

Figure 3. Comparison of two different simulations of the deformation of a 2D grid into a double curvature surface (convex and concave) still-frames sequence (left side one-point perspective) Nelson Montás (2015) based on Raviv et al. (2014). The graphic animations show a strong resemblance between the replication (bottom) and the original model (top) and simulation (middle).

References:

Davis, Daniel, *Modelled on Software Engineering: Flexible Parametric Models in the Practice of Architecture*, School of Architecture and Design College of Design and Social context, RMIT University, Melbourne, 2013.

Montás, Nelson, *Performance Software Approaches for Kinetic Architecture: Programmable Matter Based Simulations*, ESARQ, Universitat Internacional de Catalunya, Barcelona, 2015.

Raviv, Dan, Wei Zhao, Carrie McKnelly, Athina Papadopoulou, Achuta Kadambi, Boxin Shi, Shai Hirsch, Daniel Dikovsky, Michael Zyracki, Carlos Olguin, Ramesh Raskar & Skylar Tibbits, “Active Printed Materials for Complex Self-Evolving Deformations”, *Scientific Reports 4*, *Nature*, Article number: 7422, pp. 1-8, December 2014.(http://www.nature.com/articles/srep07422) retrieved:29/11/2016.

[1]http://www.dynalloy.com/tech_data_wire.php

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