# Perfect Folds for Imperfection

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## Abstract

The parametric design of component-based material and assembly systems has to often to deal very low tolerances. Furthermore, the design space of specific component systems might be limited by its possible geometric configurations. If applied to more complex and double curved geometries, this might lead to an increase in the component complexity which is leads to difficult to control fabrication and assembly scenarios.
In contrast, the presented research investigates the potential of strategically implemented material imperfection to increase the allowable tolerances and purely geometrical constraints. Based on two projects, designed and build within an educational environment, the authors demonstrate how specific material behavior and controlled inaccuracy enables the physical manufacturing of folded components, which are not foldable, in purely theoretical mathematical sense [1]. Computational methods to generate the three-dimensional geometry of folded systems are often based on rigid folding [2], which requires high accuracy to follow the mathematical rules of folding. Based on the discrepancy of the physical and theoretical folding of sheet materials, the presented projects show how physical material behavior such as bending and twisting of folded plates can be used to create soft constraints to simplify the geometric constraints, as well as the fabrication and assembly process. Thus, the design space of rigid folding can be increased by material considerations during the design process.

The authors will discuss this approach and show its potentials for the materialization of two double curved surface-like structures. They will show and explain how to implement material behavior the strategic inaccuracy into folded systems, to simplify the computational process and to enable the fabrication and assembly.

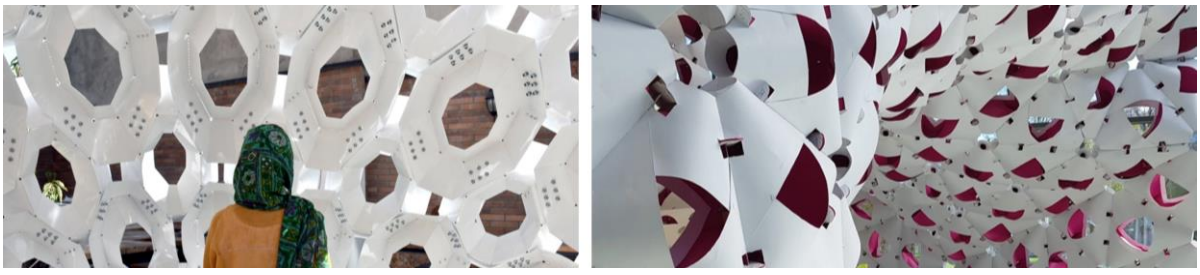

*Figure 1: Demonstrators for folded components: Folding Matters Workshop 2018 (left) and Curved-Folded Assemblies 2018 (right)*

## References

[1] E. D. M. Deimaine, V. Hart, N. Price und T. Tachi, „(Non)Existence of Pleated Folds: How Paper Folds Between Creases," *Graphs and Combinatorics*, Bd. 27, Nr. 377, 2011.

[2] T. Tachi, „Geometric Considerations for the Design of Rigid Origami Structures," in *IASS Symposium 2010 - Spatial Structures - Permanent and Temporary*, Shanghai, 2010.