Folding Mechanisms of Selected Extremely Modular Systems

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Abstract:
Extremely Modular System (EMS for short) is a relatively new concept introduced by the author a few years ago. It represents a new approach to the design of engineering structures and architectural objects where assembly of congruent units allows for the creation of free-form shapes.

The main difference from the traditional modular systems used in engineering, is the emphasis of the minimal diversity of types of modules, ideally - just one. This is why these system are extremely modular.

These are six basic advantages of EMSs:

1. Economical - as they are suitable for mass fabrication, thus lowering the cost so they can be broadly applied;
2. Functional - as they allow for reconfiguration, expansion, reduction;
3. Robust - since every module which failed can be easily replaced with an identical but functional one;
4. Discrete - as they are suitable for intelligent mathematical modeling, and their configurations can be subjected to discrete (multi-objective) optimization using efficient search algorithms;
5. Uniform - this feature is advantageous for rapid deployment and automated assembly.
6. Sustainable - as the entire modules can be reused.

One of the most advantageous areas for implementation of EMSs are deployable structures. Moreover, it is crucial that the individual modules and entire structure are rigid. This paper presents folding mechanisms for two selected EMSs: Pipe-Z - a parametric system comprised of one type of module allowing for creation of three-dimensional knots, and Truss-Z - a modular system for creating free-form ramps and ramp networks among any number of terminals.

Keywords: Extremely Modular System, Deployable Structure, Free-form, Pipe-Z, Truss-Z.