Shovel Folding: Algorithmic Origami Design of Words and Other Line Drawings

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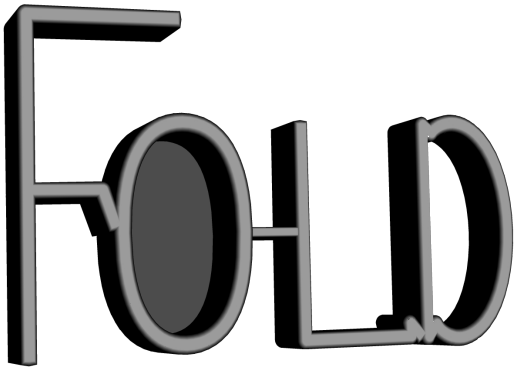
Shovel folding techniques provide a systematic approach to box-pleating to allow quick 3D origami design of line drawings without massive collapses or even an Elias stretch. It is a family of related origami techniques that work very powerfully together. It includes basic shovel folds, inverse shovel folds, half shovel folds, half inverse shovel folds, sliding shovel folds, hesitating shovel folds, null shovel folds and a "corner-turning" procedure. Inverse techniques create the same structures as their non-inverse counterparts but in reverse, causing the working end of the developing model to become narrower rather than wider. The various types of shovel folds work together in sequence across pleated paper, generating three-dimensional structures seen edge on, rather like a line drawing with three-dimensional ink hanging in mid air. This sequential nature allows a very algorithmic approach to design, including subroutines for all the capital letters of the English alphabet. These shovel-folding subroutines provide enough power that the total design time for eight new words for an exhibit was under five minutes and the first execution of all eight designs were display quality. This paper will address the underlying shovel folds, however, rather than specific subroutines built upon them.

Most shovel folding designs use a single rectangle of paper, but the technique also applies to modular design.

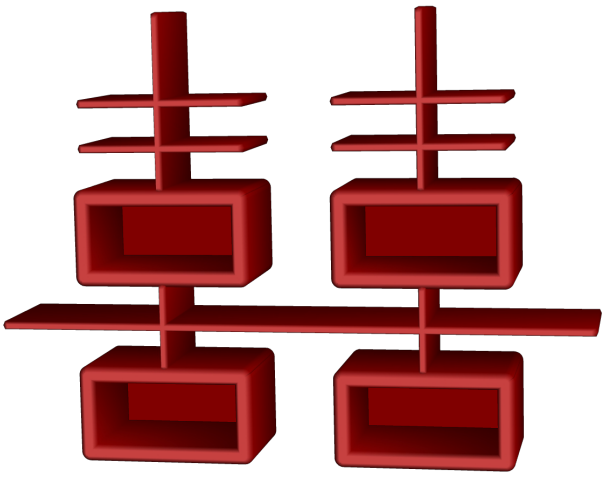
The techniques of shovel folding are not inordinately difficult. Intermediate folders with precision and patience can handle the various folding techniques required, so most models developed under this method will be intermediate or high intermediate.

Shovel folding starts on a square grid – *any* square grid. Powers of two (2) are particularly handy as grid dimensions, so the explanations will use 1:2 paper with an 8x16 grid to illustrate the techniques.

Shovel folding gets its name from the appearance of the basic shovel fold halfway through execution.



A shovel-folding design from 1:2 (8x16 grid).



A two-piece shovel-folding design.