

Symmetry With Independent Blocks

1. Introduction

The book *Shaft Weaving and Graphical Design* [MAS] presents a method for generating symmetrical profile designs using independent (*i.e.*, not combined) blocks. This paper will expand on the process and will present all possible symmetric profile tie-ups for five independent blocks.

2. The Algorithm

The algorithm to develop a symmetric pattern with respect to the first diagonal using independent blocks is straightforward:

- Draw a profile threading draft
- Draw the profile treadling “as drawn in”
- Use a tie-up that is an involute.

The result is guaranteed to be symmetrical. All one has to do is find a tie-up that is an involute [MAS], [WEL].

3. Generating the Involutes

A computer program easily generates the involutes. Table 1 gives the number of involutes for two to eight blocks.

Number of Blocks	2	3	4	5	6	7	8
Number of Involutes	2	4	10	26	76	232	764

Table 1. Number Involutes for Two to Eight Blocks

The recursion formula for this sequence is:

$$A_N = A_{N-1} + (N-1)A_{N-2}$$

This sequence [SOL] can be found in combinational theory, telephone switching theory, chess problems, and of course, weaving.

4. Profile Draft Examples

The profile drafts for two and three blocks are trivial. The result for four blocks is given in [MAS pg. 82]. Figure 1 gives the results for five blocks. Note that the involutes may be paired. Figure 2 on the last page gives a corresponding profile draft for all possible involutes of five blocks.

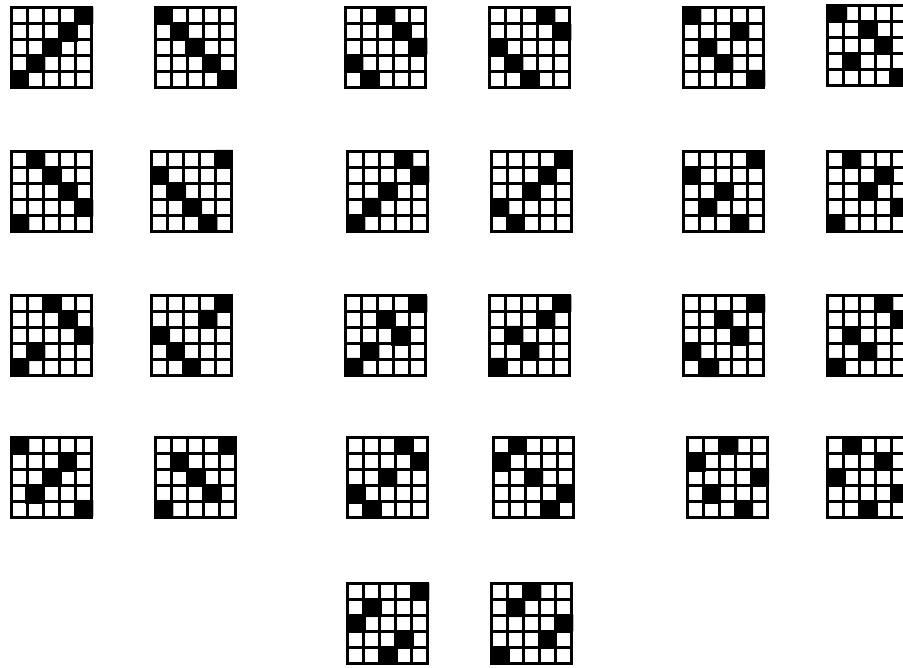


Figure 1. All Possible Involution Patterns for Five Blocks

5. Conclusion

Masson and Roussel open up new vocabulary and methods for generating designs. This paper expands on only one small aspect of their work.

6. References

[MAS] Masson O., Roussel, F., *Shaft Weaving and Graphical Design*, Les Editions en Bref, Montreal, 1988.

[SLO] Sloane N., *On-line Encyclopedia of Integer Sequences*, URL:
<http://www.research.att.com/projects/OEIS?Anum=A00085>

[WEL] Wells, A., *A Mathematical Weaver's Notes and Guide to: Shaft Weaving and Graphical Design By Oliver Masson and Francois Roussel*, 2002, URL:
www.cs.arizona.edu/patterns/weaving/webdocs/wa_mr.pdf

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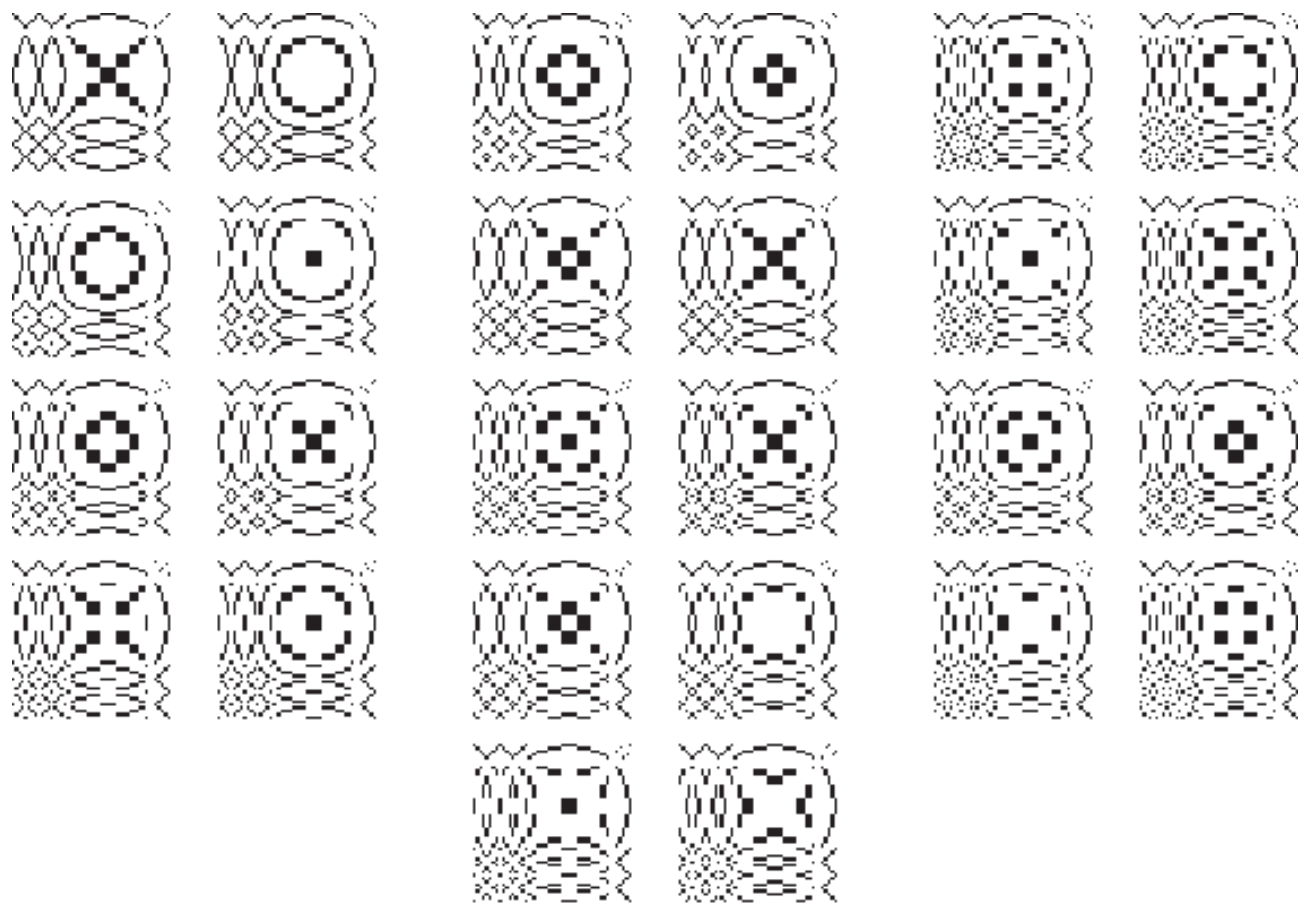


Figure 2. Profile Draft of All Possible Involutes of Five Blocks