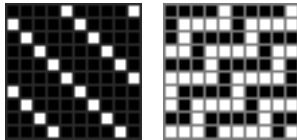


Color Complementation, Part 1: Color-Alternate Weaves

In their 1980 paper [1], Grünbaum and Shephard introduced the idea of color-alternate twills, which are obtained from standard twills by *complementing* every other row (or column). Complementing in this context means swapping colors — black for white and white for black. Here is the 4/1/4/1 twill and its color alternate:

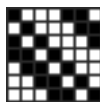


Grünbaum and Shephard commented

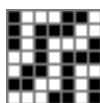
It is strange that color-alternate twills seem to have been rarely, if ever, used in practice, and we can find no reference to them in the literature. They have a characteristic and attractive appearance which may be described as a modified herring-bone effect.

Patterns of this type are easy to make. It is, however, necessary to check that the resulting interlacement is sound [2] and has floats of acceptable length.

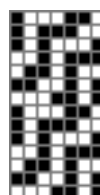
There is one potential problem. If the number of rows is odd, the first and last rows are not complemented. If the result is repeated vertically, the color-alternate effect is violated at the boundary. Consider the 1/3/2/1 twill:



Its color alternate is



If this pattern is repeated vertically, the result is

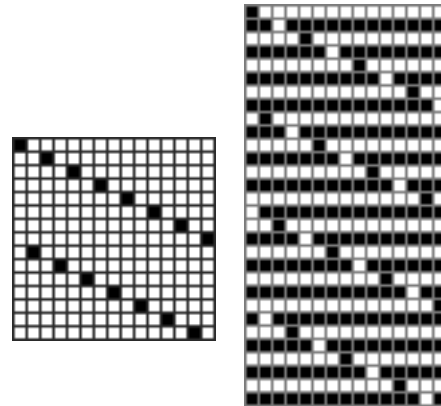


The solution to this problem is to repeat the twill vertically *before* complementation. Then the number of rows is even and the color-alternate effect applies at the boundary. Here is the 1/3/2/1 twill and its color alternate produced from a repeat:



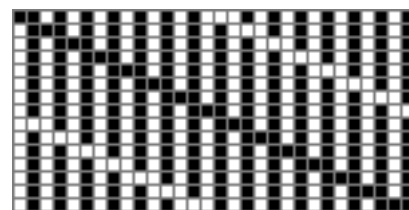
Although this pattern is attractive, it does not hang together.

The color-alternate technique can be applied to other kinds of weaves. Here is the (13,2) satin and its color alternate:

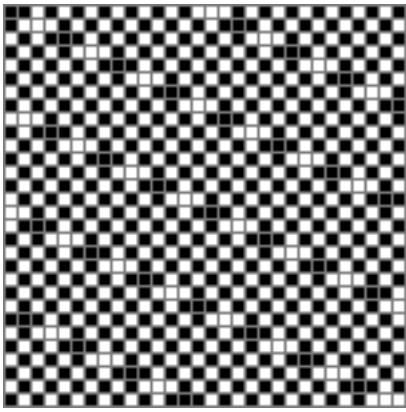


Note that the satin was repeated before complementation.

Complementation also can be done on columns. Here is the result of complementing alternate columns for the (13,2) satin:



Again, as is often the case for color alternates, neither of these patterns hang together. But there is hope. Here is the result of complementing both the rows and the columns:



It's obvious that this pattern hangs together.

As illustrated by these examples, color-alternates may have appearances that are radically

different from the weaves from which they are derived. That is not always the case. The last four pages of this article show a crackle weave, its row color alternate, its column color alternate, and its row-column color alternate. Note in particular how similar the row and column color alternates are and how similar the original and row-column color alternate are.

Other Possibilities

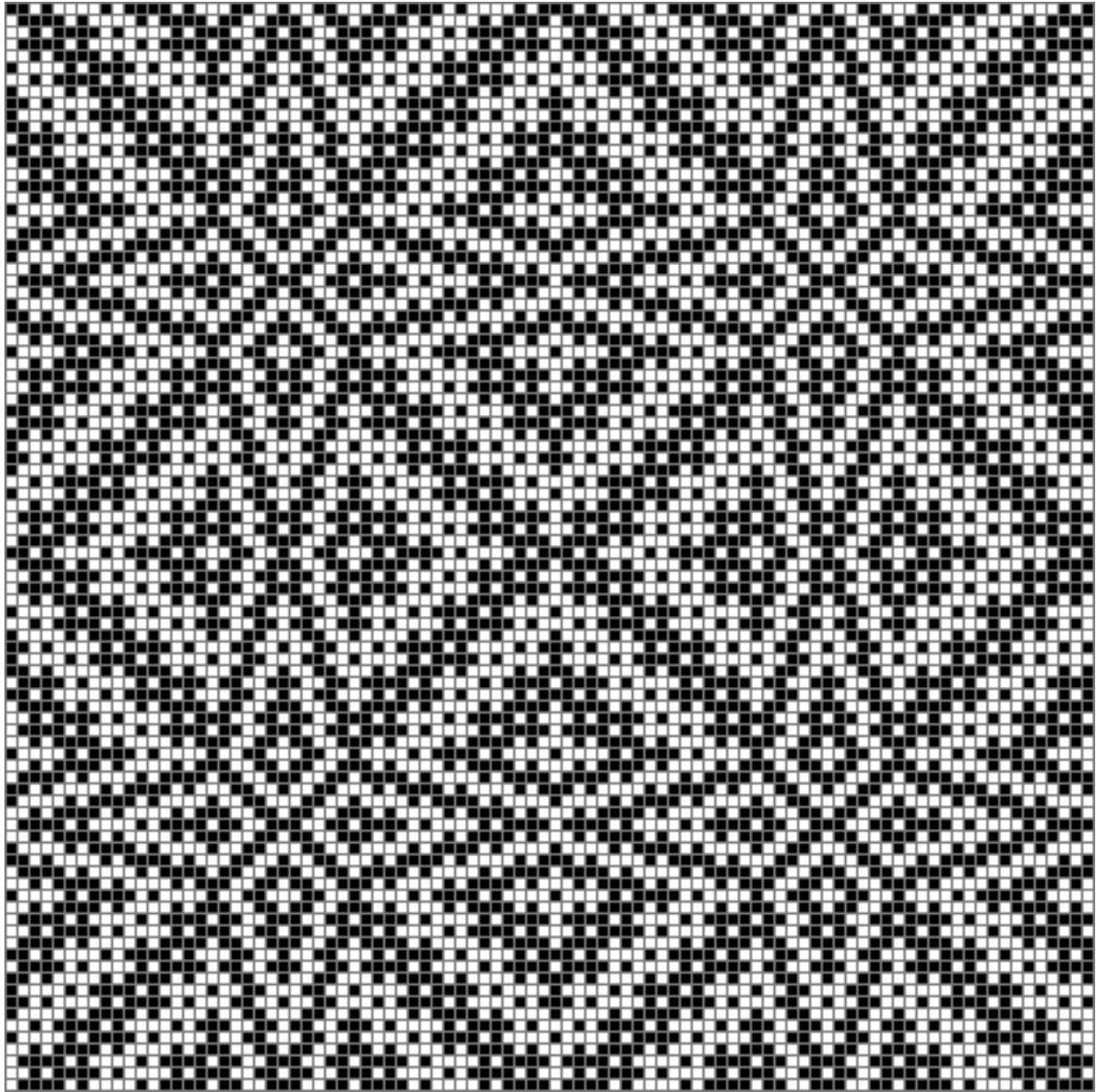
It is not necessary to complement just every other row. For example, every third row could be complemented. Ideas along this line will be the subject of a future article.

References

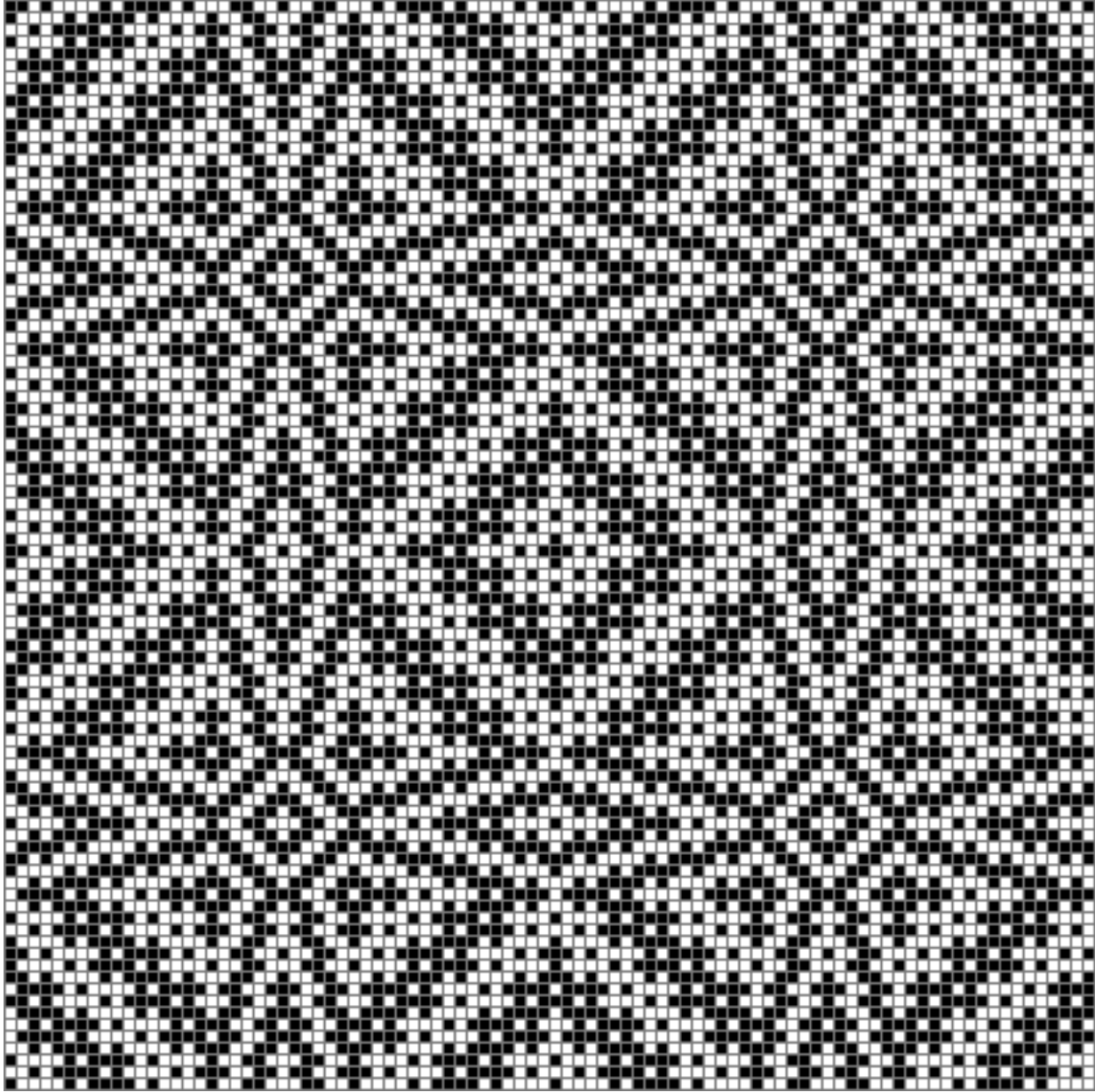
1. "Satis and Twills: An Introduction to the Geometry of Fabrics", Branko Grünbaum and Geoffrey C. Shephard. *Mathematics Magazine*, Vol. 53, No. 3 (May 1980), 139-161.
2. *When a Fabric Hangs Together (or Doesn't)*, Ralph E. Griswold, 2004:
http://www.cs.arizona.edu/patterns/weaving/webdocs/gre_hng1.pdf

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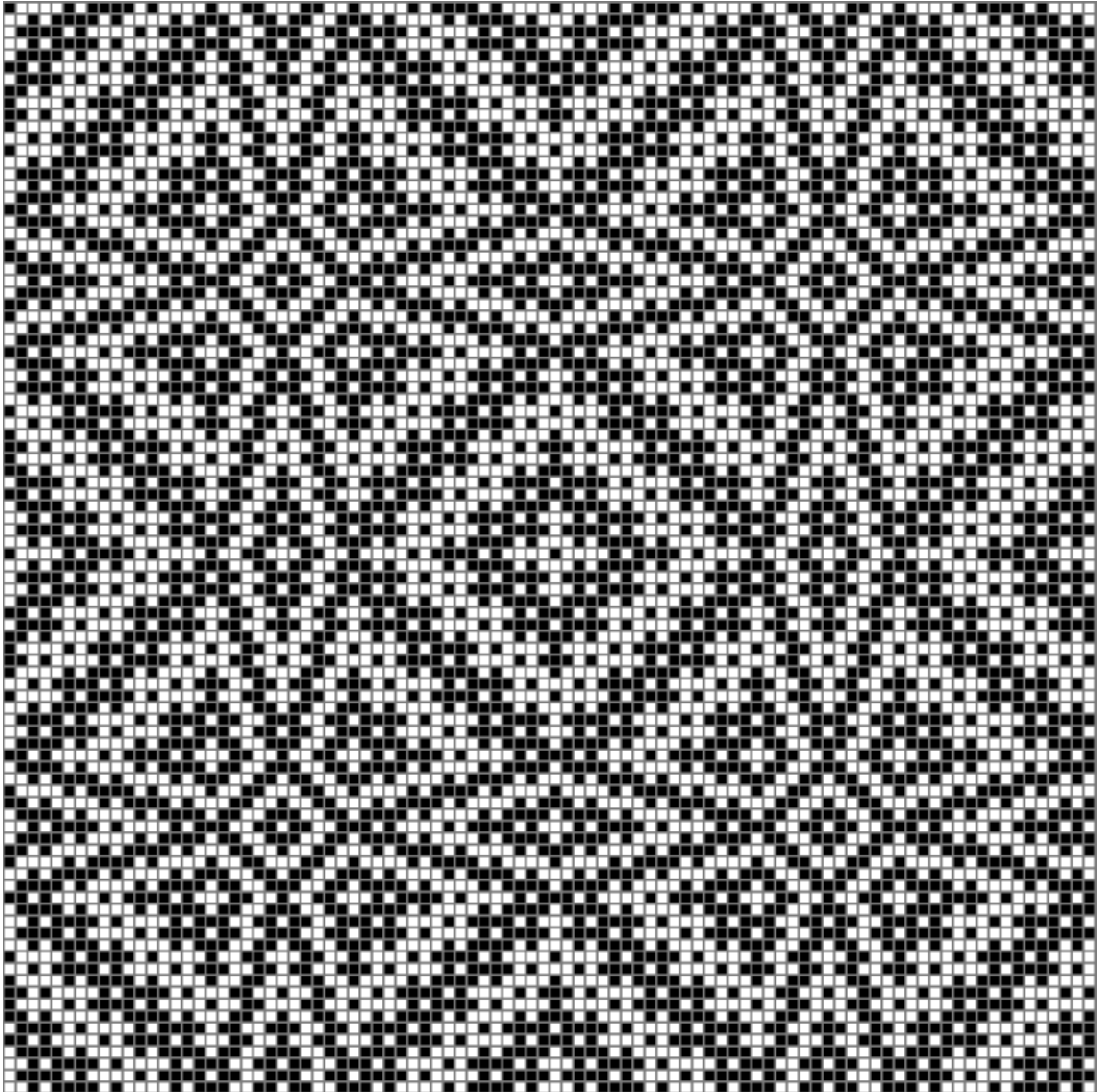
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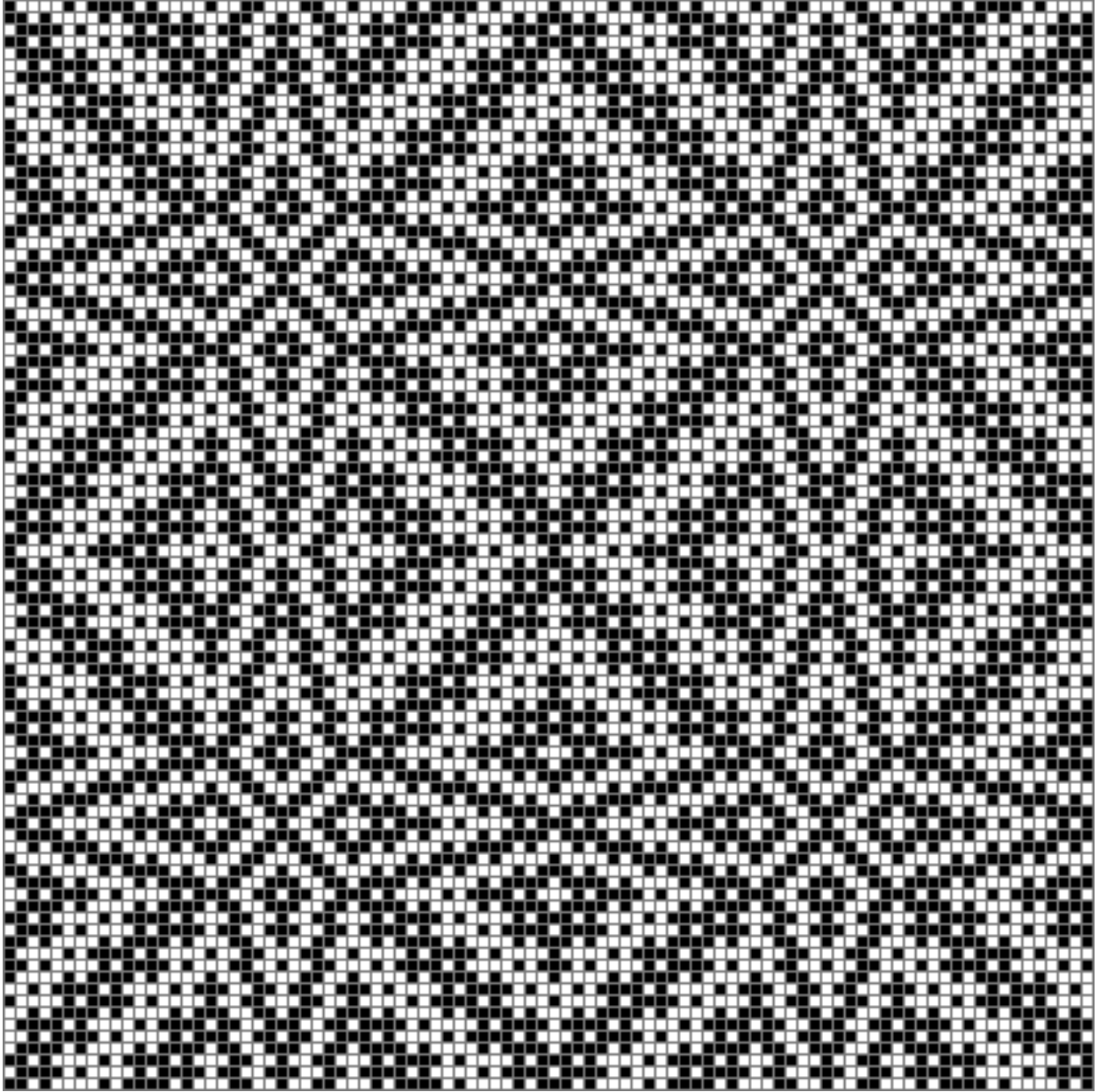
Original Crackle Weave



Row-Alternate Crackle Weave



Column Alternate Crackle Weave



Row-Column Crackle Weave