

An Introduction to Electronic String Art

Traditional string art creates curves from straight lines using nails, string, and a simple counting rule such as *connect every 7th nail*. Different counting rules (or nail locations) produce new images, but each change requires significant setup time. By contrast, *electronic string art*, **ESA**, images change instantaneously as parameters change. This allows users to rapidly adjust values and quickly test hypotheses, even if those hypotheses are only incompletely understood. Such purposeful play can lead to learning, even if that learning is informal in nature.

This chapter provides some of the basic contours of that model.

The Four ESA Parameters. Electronic String Art is a suite of models, each based on a closed set of connected line segments using a simple counting rule. **ESA** has two image creation modalities (web and *Excel*) that complement one another; The images are based on four parameters: n , S , P , and J .

ESA images are framed on regular n -gons or n , J -stars. The parameters n and J determine the *vertex frame*, **VF**, (shown in blue), given $n = 5$, $S = 3$, and $P = 4$ for $J = 1$ at left and for $J = 2$ at right. Each line of the **VF** is subdivided into S equal subdivisions, creating at most $n \cdot S$ possible subdivision endpoints (think nail locations) shown as **red dots** (in both examples, $n \cdot S = 15$). It is worth noting that all subdivision endpoints (hereafter called endpoints or dots) are points on the **VF**.

The image is created using the counting rule: draw a line connecting every P^{th} endpoint starting at the top. This first line is shown in **red** given $P = 4$. This process is repeated until the top is once again achieved in either $n \cdot S$ or fewer connected line segments. The bottom row shows two 15-line **ESA** images using this algorithm with first line overlaid in **red**.

This simple structure allows wide latitude to explore ideas, even if those ideas are incompletely understood. Users can rapidly test hypotheses and search for similarity simply by playing with the model. In the process, users can visually understand mathematics more deeply, even if that understanding is simply a by-product of such play. This purposeful play is consistent with Stein's *Triex: Explore, Extract, Explain* view of how to teach mathematics.

One form of dynamism involves how images change as the underlying parameters change. For example, the bottom left image changes into the bottom right image by changing J from 1 to 2. However, there is a second form of dynamism in **ESA**; it involves how a specific image is drawn, line by line. You can explore this using the web *Drawing Mode*, [E25.4](#).

