

## MEA: A Centered Permutation Operator with Double-Spiral Structure

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### Definition

Given a sequence length  $n$ , define the continuous center:

$$c = (n + 1) / 2$$

Let  $k$  range from 0 to  $n-1$ .

Define the MEA mapping:

$$\begin{aligned} \text{MEA}(k) = \\ c - k/2 &\text{ if } k \text{ is even} \\ c + (k+1)/2 &\text{ if } k \text{ is odd} \end{aligned}$$

For even  $n$ ,  $c$  lies between indices; for odd  $n$ ,  $c$  is an element.

### Interpretation

MEA emits indices in the pattern:

$$c, c-1, c+1, c-2, c+2, \dots$$

forming two symmetric “spiral arms” diverging from the center.

### Cycle Structure

Treating MEA as a permutation on positions, it produces finite cycles.

Examples:

- $n=7 \rightarrow$  order 6
- $n=5 \rightarrow$  order 5
- $n=8 \rightarrow$  order 7
- $n=10 \rightarrow$  order 21

This establishes MEA as a discrete centered rotation-like operator.

### Geometric Interpretation

MEA behaves like two spirals from a single stem:

- Stem: the center  $c$
- Arms:  $c \pm k$
- Alternation: even/odd  $k$  interleave the arms
- Recurrence: periodic return to identity

This structure is analogous to discrete rotational symmetry and exhibits a relationship to trig-like behaviors via symmetry, periodicity, and half-structure invariants.