Concept Flyer — Finite Structural Area Experiment (FSAE)

Squaring the Circle via Structural Geometry

Shunyaya Structural Universal Mathematics — Finite Structural Area Experiment
Status: Public Research Release (v1.3)   Date: January 01, 2026
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The Problem: Squaring the Circle (Finite Case)

The classical problem of **squaring the circle** is often treated as abstract or asymptotic.

FSAE reframes it as a finite, testable geometric experiment:

Given a circle of radius `R` and squares of side length `s`,
how many squares can be placed **fully inside the circle** under exact geometric constraints?

This is not a visual estimation.
This is a **certified counting problem**.

The Rule: Exact Geometric Certification

A square is valid **only if** all four of its corners satisfy:

```
x_corner^2 + y_corner^2 <= R^2
```

This rule is applied:

- analytically
- deterministically
- without relaxation

There are:

- no partial fits
- no tolerance-based inclusion
- no boundary smoothing

Every square is either **fully inside** or **explicitly rejected**.

Structural Geometry (Why Structure Matters)

Packing problems are often approached through:

- continuous optimization
- heuristic search
- numerical approximation

FSAE instead treats geometry as a **finite structural system**:

- square placements form lattices
- rotation introduces discrete alignment effects
- translation alters boundary interaction
- valid counts occur in **plateaus**, not smooth curves

Improvements do not arise gradually.
They arise **structurally**.

Lattice Families Compared

FSAE evaluates two lattice families under **identical rules**:

Axis-aligned lattice

- squares aligned to coordinate axes
- serves as a strict baseline

Rotated lattice

- squares rotated by angle `theta`
- optionally translated by `(dx, dy)`

Both families:

- use the same certification rule
- are evaluated deterministically
- are directly comparable

Observed improvements arise from **geometric alignment**, not relaxed constraints.

Certified Results Snapshot (Example: R=10, s=1)

Rule
`x_corner^2 + y_corner^2 <= R^2`

Certified counts (from the recorded result tables)

Axis-aligned lattice (best translation search)
277 -> 279 (**DeltaN = +2**)

Rotated lattice
277 -> 279 (**DeltaN = +2**)

Utilization
`U = (N * s^2) / (pi * R^2)`

Important
Certification binds to the exact tuple **(R, s, theta, dx, dy)**.
Any change means **NOT CERTIFIED**.

Structural note (interpretive)
These results illustrate **structural plateaus**: improvements occur only when geometric alignments change, not through smooth parameter variation.

What the Experiment Reveals

Across evaluated configurations:

- valid square counts are **discrete**
- rotation effects occur at specific angles
- many nearby angles yield identical results
- translation affects boundary saturation
- boundary gaps are unavoidable and expected

Visual density near the circle edge is **not** the metric.
Certified square count **N** is.

Browser-Verifiable and Deterministic

FSAE includes a browser-based implementation that:

• applies the same strict corner rule
• renders only certified squares
• recomputes counts deterministically

For identical inputs `(R, s, theta, dx, dy, centers)`, FSAE guarantees identical square counts and pass/fail outcomes across machines.

There is no randomness, no hidden state, and no execution-order dependence.
Failures are explicit. Silent errors are not allowed.

What FSAE Is (and Is Not)

FSAE is:

• a finite geometric experiment
• a certified counting framework
• a deterministic structural analysis

FSAE is not:

• a numerical approximation
• a Monte Carlo simulation
• a heuristic packing algorithm
• a visual estimation tool

It does not predict limits.
It certifies only what is explicitly placed and verified.

Why FSAE Matters

FSAE demonstrates that classical geometric problems reveal new insight when approached through:

• finite constraints
• exact certification
• deterministic structure

It reframes squaring the circle as a structural geometry problem, not a symbolic impossibility or an asymptotic abstraction.

Finite geometry. Exact rules. Certified results.

OMP