

EXTENDING HRIDAYA KOLAM TO MULTIPLE LOOPS: A STUDY OF NON-COPRIME DOT–ARM STRUCTURES

Atanu Manna¹ and Suvra Kanti Chakraborty²

¹Indian Institute of Carpet Technology,
Chauri Road, Bhadohi–221401, Uttar Pradesh, India
Email: atanu.manna@iict.ac.in; atanuiitkgp86@gmail.com

²Department of Mathematics
Ramakrishna Mission Vidyamandira, Belur Math–711202, West Bengal, India
Email: suvrakanti@vidyamandira.ac.in (Corresponding author)

Abstract. This paper extends Hridaya Kolam patterns to cases where the number of dots (m) and arms (n) are not coprime, i.e., $\gcd(m, n) \neq 1$. Such configurations give rise to multiple disjoint closed loops. We propose a modular-arithmetic-based algorithm to systematically generate such patterns, and illustrative patterns for various non-coprime (m, n) pairs are presented to demonstrate the resulting multi-loop structures. These multi-loop Kolam designs can inspire architectural motifs and ornamental patterns in floor plans, facades, and decorative elements.

Keywords. Hridaya Kolam, Modular arithmetic, Algorithmic pattern generation, Modular sequence, Multiple loops.

AMS (MSC 2020) subject classification: 00A66, 11A07, 68U05

1 INTRODUCTION

Kolam (or Kamalam) is a traditional Indian floor art of geometric and symmetrical patterns, drawn with rice flour or limestone powder, especially in South India. Known by different regional names—such as Muggulu, Alpana, Mandana, and Rangoli—these designs symbolize devotion, cultural identity, and aesthetic order. Their symbolic geometry and use of natural materials have drawn interdisciplinary interest, particularly in computational modeling and data representation [2, 12].

A foundational study of Hridaya Kamalam Kolam featuring radial dot arrangements was conducted by Siromoney [15] and later by Siromoney and Chandrasekaran [14], focusing on cases with an odd number of dots per arm and coprime arm counts. Ascher’s formal language approach [1], Naranan’s Fibonacci-based constructions [7, 8, 9, 10], and the diagrammatic analyses