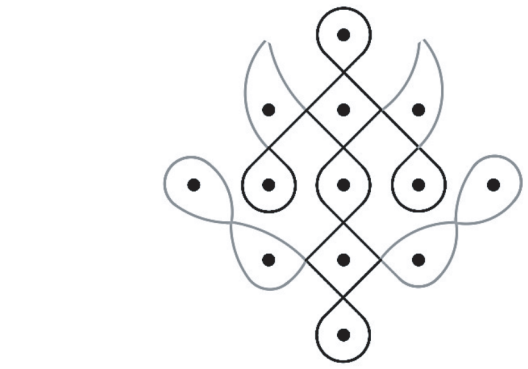

$O_4$, $O_1$, $O_1$, $O_4$, $H_{3L}$, $O_1$, $O_2$, $O_1$, $T_2$, $D_{4R}$, $T_{1L}$, $O_1$,
$O_4$, $O_1$, $T_1$, $D_{4R}$, $T_{2L}$, $O_1$, $O_2$, $O_1$, $H_{3R}$, $O_4$, $O_1$, $O_1$

Fig. 6. The 'temple lamp' hybrid SLK pattern of Fig. 3a1. The pattern combines traditional, orthogonal gestures (in black) with new gestures (in grey) to create a very common kolam pattern called the 'temple lamp.' The sequential code is given below the kolam, beginning with the topmost $O_4$ gesture.

agonal or orthogonal) are gestures of that type, while gestures that move from diagonal to orthogonal or back are transitional gestures. Each set of gestures (orthogonal, diagonal, transitional) is represented by a letter (O, D, T, respectively), while stylistic variants of these moves are given special letters (C, H, P) denoting their shapes or the shapes of their root gestures (circle, horn, point, respectively). Because both orthogonal and diagonal positions have four fundamental positions around each dot, they are notated in the same way. Within each of the (O, D, T) gesture sets, a subscript denotes the number of sides (out of four) around a focal dot that the gesture has curved. $O_1$ and $D_1$ represent passage past the focal dot of along one side of four sides, and both $O_1$ and $D_1$ occur without change of orientation. $O_2$, $D_2$ and $T_2$ represent passing by two of the four sides, and $O_n$, $D_n$ and $T_n$ likewise represent gestures that curve around n sides of the focal dot. In addition, both diagonal and transitional gestures from diagonal positions are chiral, and are additionally denoted with subscripts L and R. Stylistic gestures in the $C_n$ gesture set must operate as the basic circle gesture, $C_1$, in that each must be a single-dot $C_n$ gesture must be a complete motif in isolation, and not connect with other gestures around nearby dots. The full lexicon of 30 gestures is presented in Fig. 5.

The expanded SLK lexicon, with 30 gestures, is six times larger than the simple orthogonal lexicon used in previous research (see Fig. 2). These additional gestures allow researchers to represent a much greater fraction of real-world kolam patterns than the simple orthogonal lexicon. For example, a common SLK pattern is the simple 'temple lamp' kolam. The 'temple lamp' is composed of gestures from all four subsets of the expanded lexicon; orthogonal, diagonal, transitional, and stylistic series. Figure 6 displays the 'temple lamp' kolam, and the sequential encoding needed to generate that kolam using the expanded lexicon.

## 4. Analysis

Clearly increasing the size of the SLK lexicon six-fold will have a multiplicative effect on the number of possible patterns within a diamond (e.g. 1-5-1) or rectangular array

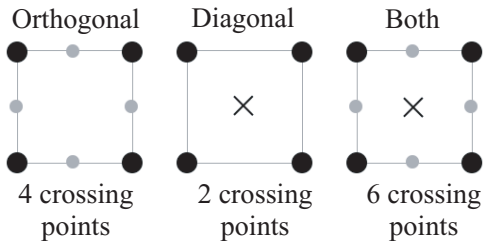


Fig. 7. Crossing points for both orthogonal and diagonal fundamental positions. Black dots are kolam dots (*pulli* in Tamil), grey dots are orthogonal crossing points, and each diagonal line marks a diagonal crossing point. Two diagonal crossing points occur in the geometrical middle of each set of four neighbor dots, with orientations 45° (225°) and 135° (315°).

(e.g. 4x4), and therefore the fraction of the creative space that kolam artists use that may be sequentially encoded.

Previously, various scholars have measured the size of the kolam design space given various initial dot matrices using the orthogonal lexicon. The size of the kolam design space (or the number of possible kolam patterns) increases exponentially with the width of the initial dot matrix. For example, using traditional gestural lexicon, Nagata (2006) calculated that a square dot matrix of size 2×2 only allows five possible multiple loop configurations, while a 3×3 matrix has 785 configurations (Nagata, 2006). Similarly, Ishimoto (2006) found that for the 1-5-1 diamond matrix the number of single loop patterns was calculated to be 240, while for the 1-7-1 diamond matrix the number is 11,661,312. Yanagisawa and Nagata (2007) go further by determining the number of total patterns, and then removing rotational duplicates, counting symmetric patterns, and finally single-loop symmetric patterns. They confirm that for the 1-5-1 diamond matrix the number of single loop symmetrical patterns is only 240, while a total of 65,536 patterns are possible if the number of loops is not restricted. Similarly, out of a total of 68,719,476,736 patterns possible in a 1-7-1 diamond there are 11,661,312 one-stroke patterns, and only 1,520 of these are symmetrical.

Yanagisawa and Nagata (2007) utilized a space-filling