Surrogate model for the Overhang structure of AM.

I have 2\*4\*5 lattice structure to build the supporting structure. To reduce the number of input variables, I combined two lattices together, which are in the same perpendicular line. Therefore, I make the number of variables to be 20. For each variable, I have four plan for them, A, B, C, and D. They are corresponding to the layout of 0 0, 0 1, 1 0, 1 1. First is on the upper layer, second is on the lower layer.

# 0 is the representation of one value of the lattice diameter, and 1 is another value for the lattice diameter.

# The array start from the hanging side to the inner side, from the left side to the right side.

I use the package of python named **numpy.random** to help me create the random layout for those twenty variables.

**“ “ means not been test; ## means is testing; && means already being tested.**

1. **[[A, A, A, A], [A, A, A, A], [A, A, A, A], [A, A, A, A], [A, A, A, A]]**

The plan for the layout is as below.

1. **b[ 0 ][][]:\_\_ [['A', 'B', 'C', 'D'], ['C', 'B', 'B', 'C'], ['B', 'D', 'C', 'D'], ['C', 'D', 'B', 'C'], ['A', 'D', 'B', 'B']]**

**&&**

1. **b[ 1 ][][]:\_\_ [['A', 'B', 'B', 'B'], ['B', 'A', 'A', 'A'], ['D', 'A', 'C', 'D'], ['C', 'C', 'B', 'A'], ['A', 'B', 'A', 'C']]**

**&&**

1. **b[ 2 ][][]:\_\_ [['D', 'D', 'C', 'C'], ['B', 'B', 'B', 'D'], ['C', 'B', 'A', 'A'], ['D', 'D', 'D', 'A'], ['C', 'B', 'A', 'D']]**

**&&**

1. **b[ 3 ][][]:\_\_ [['C', 'A', 'C', 'A'], ['B', 'D', 'A', 'B'], ['B', 'A', 'D', 'D'], ['D', 'C', 'C', 'C'], ['B', 'C', 'B', 'B']]**

**&&**

1. **b[ 4 ][][]:\_\_ [['A', 'B', 'C', 'A'], ['A', 'C', 'C', 'B'], ['A', 'D', 'C', 'C'], ['D', 'D', 'D', 'D'], ['A', 'A', 'D', 'C']]**

**&&**

1. **b[ 5 ][][]:\_\_ [['C', 'B', 'A', 'A'], ['D', 'A', 'A', 'C'], ['D', 'B', 'C', 'B'], ['B', 'C', 'D', 'A'], ['B', 'C', 'C', 'D']]**

**&&**

1. **b[ 6 ][][]:\_\_ [['C', 'B', 'B', 'C'], ['C', 'D', 'C', 'C'], ['C', 'A', 'D', 'A'], ['C', 'B', 'A', 'D'], ['B', 'D', 'B', 'C']]**

**&&**

1. **b[ 7 ][][]:\_\_ [['D', 'D', 'C', 'D'], ['A', 'B', 'A', 'C'], ['C', 'A', 'C', 'C'], ['A', 'A', 'B', 'A'], ['B', 'A', 'A', 'C']]**

**&&**

1. **b[ 8 ][][]:\_\_ [['A', 'C', 'C', 'B'], ['D', 'B', 'B', 'C'], ['D', 'B', 'B', 'B'], ['D', 'C', 'C', 'C'], ['A', 'C', 'A', 'A']]**

**&&**

1. **b[ 9 ][][]:\_\_ [['D', 'A', 'D', 'D'], ['C', 'D', 'B', 'A'], ['C', 'B', 'A', 'A'], ['C', 'C', 'D', 'C'], ['A', 'B', 'A', 'B']]**

**&&**

1. **b[ 10 ][][]:\_\_ [['D', 'C', 'B', 'B'], ['D', 'B', 'B', 'A'], ['C', 'A', 'B', 'C'], ['C', 'D', 'B', 'C'], ['D', 'C', 'B', 'D']]**

**## Boolean Operation failed**

1. **b[ 11 ][][]:\_\_ [['D', 'D', 'A', 'C'], ['B', 'B', 'B', 'B'], ['A', 'D', 'D', 'D'], ['A', 'A', 'C', 'A'], ['D', 'A', 'D', 'C']]**

**&&**

1. **b[ 12 ][][]:\_\_ [['A', 'B', 'C', 'B'], ['D', 'C', 'A', 'A'], ['A', 'C', 'B', 'A'], ['A', 'C', 'D', 'B'], ['B', 'A', 'D', 'D']]**

**&&**

1. **b[ 13 ][][]:\_\_ [['B', 'D', 'C', 'B'], ['A', 'C', 'A', 'A'], ['C', 'C', 'D', 'D'], ['D', 'C', 'D', 'A'], ['C', 'D', 'C', 'A']]**

**&&**

1. **b[ 14 ][][]:\_\_ [['C', 'C', 'C', 'D'], ['B', 'B', 'B', 'B'], ['D', 'B', 'D', 'D'], ['D', 'D', 'A', 'C'], ['D', 'C', 'A', 'B']]**

**&&**

1. **b[ 15 ][][]:\_\_ [['D', 'C', 'C', 'B'], ['C', 'D', 'D', 'A'], ['D', 'B', 'A', 'D'], ['A', 'B', 'A', 'A'], ['D', 'D', 'D', 'B']]**

**&&**

1. **b[ 16 ][][]:\_\_ [['D', 'D', 'B', 'B'], ['A', 'D', 'B', 'A'], ['B', 'D', 'C', 'C'], ['D', 'D', 'B', 'C'], ['D', 'C', 'B', 'B']]**

**&&**

1. **b[ 17 ][][]:\_\_ [['B', 'D', 'C', 'B'], ['A', 'B', 'A', 'A'], ['D', 'B', 'A', 'A'], ['A', 'D', 'B', 'A'], ['B', 'B', 'A', 'D']]**

**## Boolean Operation failed**

1. **b[ 18 ][][]:\_\_ [['D', 'B', 'D', 'B'], ['D', 'C', 'A', 'D'], ['A', 'B', 'C', 'D'], ['B', 'A', 'C', 'C'], ['B', 'B', 'C', 'B']]**

**&&**

1. **b[ 19 ][][]:\_\_ [['C', 'C', 'C', 'B'], ['A', 'D', 'D', 'D'], ['D', 'D', 'A', 'A'], ['C', 'C', 'D', 'C'], ['B', 'A', 'A', 'D']]**

**&&**

1. **b[ 20 ][][]:\_\_ [['A', 'C', 'B', 'C'], ['B', 'B', 'D', 'C'], ['A', 'A', 'D', 'A'], ['A', 'C', 'C', 'A'], ['B', 'D', 'D', 'A']]**

**&&**

1. **b[ 21 ][][]:\_\_ [['A', 'C', 'A', 'D'], ['B', 'B', 'A', 'B'], ['D', 'B', 'D', 'D'], ['B', 'B', 'C', 'A'], ['C', 'B', 'A', 'B']]**

**&&**

1. **b[ 22 ][][]:\_\_ [['D', 'B', 'B', 'A'], ['D', 'D', 'C', 'B'], ['C', 'D', 'C', 'C'], ['D', 'D', 'C', 'D'], ['D', 'C', 'C', 'A']]**

**&&**

1. **b[ 23 ][][]:\_\_ [['B', 'A', 'B', 'C'], ['A', 'B', 'B', 'B'], ['A', 'C', 'C', 'A'], ['B', 'C', 'D', 'B'], ['D', 'D', 'C', 'C']]**

**&&**

1. **b[ 24 ][][]:\_\_ [['A', 'D', 'D', 'A'], ['B', 'C', 'A', 'B'], ['A', 'D', 'B', 'B'], ['C', 'A', 'A', 'B'], ['B', 'B', 'B', 'A']]**

**&&**