

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.

0. [[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']]  
&&
2. b[ 1 ][]: \_\_ [['A', 'B', 'B', 'B'], ['B', 'A', 'A', 'A'], ['D', 'A', 'C', 'D'], ['C', 'C', 'B', 'A'], ['A', 'B', 'A', 'C']]  
&&
3. b[ 2 ][]: \_\_ [['D', 'D', 'C', 'C'], ['B', 'B', 'B', 'D'], ['C', 'B', 'A', 'A'], ['D', 'D', 'D', 'A'], ['C', 'B', 'A', 'D']]  
&&
4. b[ 3 ][]: \_\_ [['C', 'A', 'C', 'A'], ['B', 'D', 'A', 'B'], ['B', 'A', 'D', 'D'], ['D', 'C', 'C', 'C'], ['B', 'C', 'B', 'B']]  
&&
5. b[ 4 ][]: \_\_ [['A', 'B', 'C', 'A'], ['A', 'C', 'C', 'B'], ['A', 'D', 'C', 'C'], ['D', 'D', 'D', 'D'], ['A', 'A', 'D', 'C']]  
&&
6. b[ 5 ][]: \_\_ [['C', 'B', 'A', 'A'], ['D', 'A', 'A', 'C'], ['D', 'B', 'C', 'B'], ['B', 'C', 'D', 'A'], ['B', 'C', 'C', 'D']]  
&&
7. b[ 6 ][]: \_\_ [['C', 'B', 'B', 'C'], ['C', 'D', 'C', 'C'], ['C', 'A', 'D', 'A'], ['C', 'B', 'A', 'D'], ['B', 'D', 'B', 'C']]  
&&
8. b[ 7 ][]: \_\_ [['D', 'D', 'C', 'D'], ['A', 'B', 'A', 'C'], ['C', 'A', 'C', 'C'], ['A', 'A', 'B', 'A'], ['B', 'A', 'A', 'C']]  
&&
9. b[ 8 ][]: \_\_ [['A', 'C', 'C', 'B'], ['D', 'B', 'B', 'C'], ['D', 'B', 'B', 'B'], ['D', 'C', 'C', 'C'], ['A', 'C', 'A', 'A']]  
&&
10. b[ 9 ][]: \_\_ [['D', 'A', 'D', 'D'], ['C', 'D', 'B', 'A'], ['C', 'B', 'A', 'A'], ['C', 'C', 'D', 'C'], ['A', 'B', 'A', 'B']]  
&&
11. 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
12. b[ 11 ][]: \_\_ [['D', 'D', 'A', 'C'], ['B', 'B', 'B', 'B'], ['A', 'D', 'D', 'D'], ['A', 'A', 'C', 'A'], ['D', 'A', 'D', 'C']]  
&&
13. b[ 12 ][]: \_\_ [['A', 'B', 'C', 'B'], ['D', 'C', 'A', 'A'], ['A', 'C', 'B', 'A'], ['A', 'C', 'D', 'B'], ['B', 'A', 'D', 'D']]  
&&

14. b[ 13 ][]: \_\_ [['B', 'D', 'C', 'B'], ['A', 'C', 'A', 'A'], ['C', 'C', 'D', 'D'], ['D', 'C', 'D', 'A'], ['C', 'D', 'C', 'A']]  
&&

15. b[ 14 ][]: \_\_ [['C', 'C', 'C', 'D'], ['B', 'B', 'B', 'B'], ['D', 'B', 'D', 'D'], ['D', 'D', 'A', 'C'], ['D', 'C', 'A', 'B']]  
&&

16. b[ 15 ][]: \_\_ [['D', 'C', 'C', 'B'], ['C', 'D', 'D', 'A'], ['D', 'B', 'A', 'D'], ['A', 'B', 'A', 'A'], ['D', 'D', 'D', 'B']]  
&&

17. b[ 16 ][]: \_\_ [['D', 'D', 'B', 'B'], ['A', 'D', 'B', 'A'], ['B', 'D', 'C', 'C'], ['D', 'D', 'B', 'C'], ['D', 'C', 'B', 'B']]  
&&

18. 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

19. b[ 18 ][]: \_\_ [['D', 'B', 'D', 'B'], ['D', 'C', 'A', 'D'], ['A', 'B', 'C', 'D'], ['B', 'A', 'C', 'C'], ['B', 'B', 'C', 'B']]  
&&

20. b[ 19 ][]: \_\_ [['C', 'C', 'C', 'B'], ['A', 'D', 'D', 'D'], ['D', 'D', 'A', 'A'], ['C', 'C', 'D', 'C'], ['B', 'A', 'A', 'D']]  
&&

21. b[ 20 ][]: \_\_ [['A', 'C', 'B', 'C'], ['B', 'B', 'D', 'C'], ['A', 'A', 'D', 'A'], ['A', 'C', 'C', 'A'], ['B', 'D', 'D', 'A']]  
&&

22. b[ 21 ][]: \_\_ [['A', 'C', 'A', 'D'], ['B', 'B', 'A', 'B'], ['D', 'B', 'D', 'D'], ['B', 'B', 'C', 'A'], ['C', 'B', 'A', 'B']]  
&&

23. b[ 22 ][]: \_\_ [['D', 'B', 'B', 'A'], ['D', 'D', 'C', 'B'], ['C', 'D', 'C', 'C'], ['D', 'D', 'C', 'D'], ['D', 'C', 'C', 'A']]  
&&

24. b[ 23 ][]: \_\_ [['B', 'A', 'B', 'C'], ['A', 'B', 'B', 'B'], ['A', 'C', 'C', 'A'], ['B', 'C', 'D', 'B'], ['D', 'D', 'C', 'C']]  
&&

25. b[ 24 ][]: \_\_ [['A', 'D', 'D', 'A'], ['B', 'C', 'A', 'B'], ['A', 'D', 'B', 'B'], ['C', 'A', 'A', 'B'], ['B', 'B', 'B', 'A']]  
&&