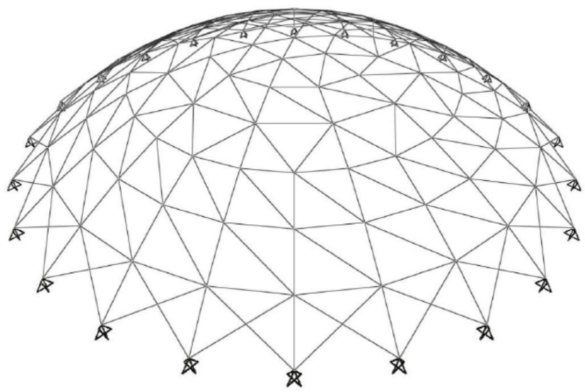
Optimization problem of the ISCSO 2013

Consider the sizing optimization of the 354-member space truss structure shown below. Here, the truss members are to be selected from a discrete set of 37 ready sections. For the sake of simplicity the objective function of this optimization problem is given as a MATLAB code function (iscso.m) and you are asked to minimize this function using discrete solution variables.



354-member truss dome

In order to use the given objective function, first you need to propose your solution vector (X) as:

$$X = [x_1 , x_2 , x_3 , \ldots , x_{354}]$$

where x_1 to x_{354} can take only integer values ranging from 1 through 37 (including both 1 and 37).

Next, using the following MATLAB command you can get the corresponding objective function value which is the penalized weight of the truss structure.

[Objective_Function] = iscso(X)

You can choose any optimization technique to minimize this function. Further, you may propose a new optimization algorithm or a hybrid form of previously proposed algorithms.

Please do the following steps:

1) Stop running your algorithm when it finds a solution vector (X) having an objective function value smaller than 15000 and report the solution found.

Note: Only reporting a solution having an objective function value smaller than 15000 is enough for this step. Better solutions will not be given any priority.

2) Report the number of objective function evaluations of your algorithm to obtain the solution you reported.

Note: You can perform numerous runs with your algorithm and report the best one.

3) For your reported solution present an optimization history graph which shows the value of objective function (vertical axis) versus the number of objective function evaluations (horizontal axis) in the course of optimization.

4) Submit the optimization results, the MATLAB code, and a brief description of the employed method (maximum five A4 pages in English) in a PDF format before the deadline.

Good Luck!

The reported design by *LLBo Juniors* team

Group Index	Design Variable Index	Group Size	Optimal Value
1	1,2,3,4,5,6,7,8,9,10,11,12 13,14,15,16,17,18,19,20,21,22,23,24 26,28,30,32,34,36,38,40,42,44,46,48 50,52,54,56,58,60,62,64,66,68,70,72	48	13
2	25,27,29,31,33,35,37,39,41,43,45,47 49,51,53,55,57,59,61,63,65,67,69,71	24	18
3	73,74,75,76,77,78,79,80,81,82,83,84 85,86,87,88,89,90,91,92,93,94,95,96	24	9
4	97,99,101,103,105,107,109,111,113,115,117,119 121,123,125,127,129,131,133,135,137,139,141,143	24	17
5	98,100,102,104,106,108,110,112,114,116,118,120 122,124,126,128,130,132,134,136,138,140,142,144	24	5
6	145,146,147,148,149,150,151,152,153,154,155,156 157,158,159,160,161,162,163,164,165,166,167,168	24	12
7	169,171,173,175,177,179,181,183,185,187,189,191 193,195,197,199,201,203,205,207,209,211,213,215	24	17
8	170,172,174,176,178,180,182,184,186,188,190,192 194,196,198,200,202,204,206,208,210,212,214,216	24	7
9	217,218,219,220,221,222,223,224,225,226,227,228 229,230,231,232,233,234,235,236,237,238,239,240	24	13
10	241,244,247,250,253,256,259,262,265,268,271,274	12	14
11	242,243,245,246,248,249,251,252,254,255,257,258 260,261,263,264,266,267,269,270,272,273,275,276	24	15
12	277,278,279,280,281,282,283,284,285,286,287,288	12	1
13	289,291,293,295,297,299,301,303,305,307,309,311	12	20
14	290,292,294,296,298,300,302,304,306,308,310,312	12	7
15	313,314,315,316,317,318,319,320,321,322,323,324	12	9
16	325,328,331,334,337,340	6	21
17	326,327,329,330,332,333,335,336,338,339,341,342	12	15
18	343,344,345,346,347,348	6	32
19	349,350,351,352,353,354	6	37
Objective function value: 14938.2			Number of evaluations: 853

Note: The grouping approach used by *LLBo Juniors* has reduced the dimension of the design space from 354 to 19. The employed grouping is based on a deterministic and numeric approach which does not need any structural system information and uses only the objective function value to identify the groups.

BRIGHT OPTIMIZER

ISCSO 2013

The winner of ISCSO 2013, *LLBo Juniors* team, from Technical University of Munich

LLBo Juniors team members

Markus Schatz

Qian Xu

Markus Schatz born in Friedrichshafen (Baden-Württemberg in Germany) studied aerospace at the Technical University of Munich and made his diploma thesis at the space structures laboratory of the California Institute of Technology. Currently, he is studying at the Technical University of Munich as a PhD student. Qian Xu born in Wuhan (Hubei in China) studied aerospace at the Beijing Institute of Technology and made her Bachelor's and Master's thesis there. She is currently a PhD student at the Technical University of Munich. Her research topics are multidisciplinary design optimization and surrogate modeling techniques.