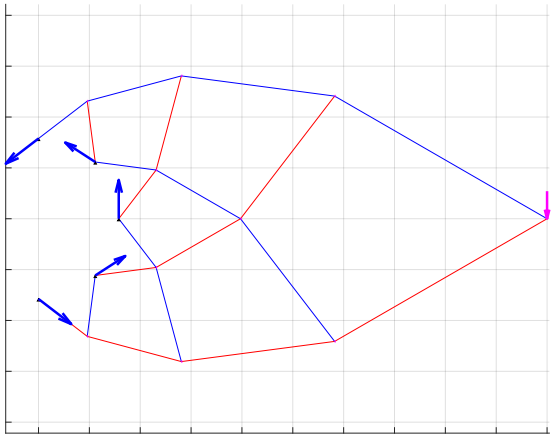
HW1 Report

Aobo Yang A53286372

1. Michell Truss of order 4

According to Tom's paper, the conditions of static equilibrium could be represented with matrix form: $A_{se}x = u$. A_{se} is a m*n matrix, with m=dimension of problem (d) * number of free nodes (q), n = number of bars (b) + number of strings (s). When performing SVD on the matrix, four conditions are derived to describe the condition of equations of static equilibrium: 1) potentially inconsistent; 2) underdetermined; 3) both potentially inconsistent and underdetermined; 4) neither potentially inconsistent nor underdetermined. The tensegrity structure is realizeable with at least one solution exists with all strings in tension.

Test results of Michell Truss of order 4 is shown below



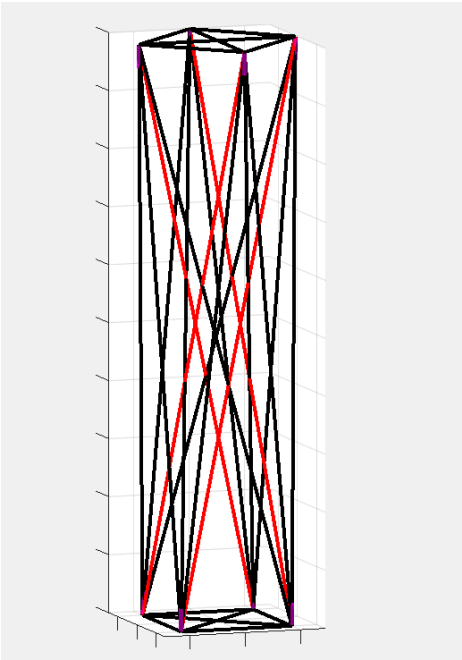
After applying a vertical vertical downward force to the free nodes of the structure, the has shown below:

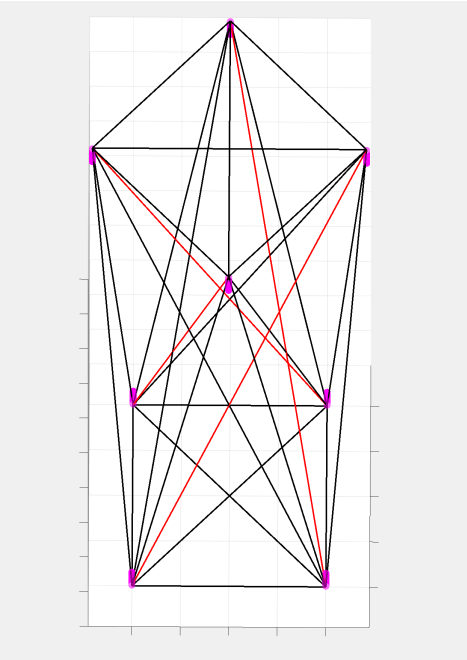
The Ase is not potentially inconsistent. Which means all of the rows of Ase is linear independent. According to Tom's paper, r>=dq. The nominal loading profile u0 is stable, which is a realizable equilibrium of a corresponding tensegrity. Also, there is no soft nodes exists in the structure because of non-potentially inconsistent.

The Ase is not underdetermined. This shows that when a vertical downward force applied (like gravity), all of the bars are under compression and all strings are not tensionable. This is a desirable structure with no soft nodes and would note exists deformation because of external force interference.

2. Non minimal tensegrity prism with 4 bars

Test results are shown below (applied vertical downward force on top 4 points and vertical upward force on bottom 4 points):





Ase of my designed structure is potentially inconsistent, implying the presence of soft modes, or instability. There exist soft nodes and might need more strings or fixed points to fix the problem. Also, some strings are not under tension, actually I need to apply horizonal pull on all of the 8 points in construct which would eliminate the strings not tensionable problem. The Ase is underdetermined with 10 DOF, but not pretensionable. No bars are under tension and the 24 strings are all under tension with tau_min=2.5488. Which means all strings are still tensionable under load.