HW1 Report

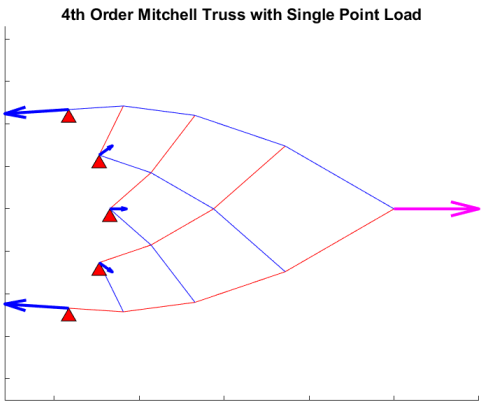
Michell Truss

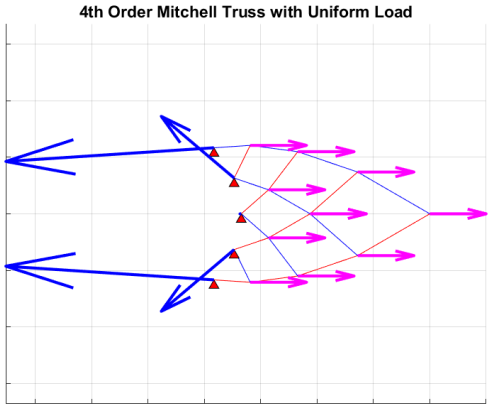
In this part, various features of a 4th order Michell truss are discussed.

A Michell truss is a type of truss structure that consists of some Michell spirals. The order of the Michell truss structure is determined by the longest spiral in the structure. For example, a 4th order Michell spiral means that there are 4 nodes in the spiral, excluding the origin node.

A truss structure can be potentially inconsistent, underdetermined, both inconsistent and underdetermined, or neither. If a truss structure is potentially inconsistent, the corresponding tensegrity configuration can be either unstable or soft. An unstable configuration can easily lead to failure when an external disturbance is applied. A soft configuration, on the other hand, is not catastrophic as it does not easily lead to failure. However, a soft configuration is likely to have different deformations under different external disturbance and is thus undesirable. If a structure is underdetermined, the control authority of the force distribution is allowed. Additionally, most underdetermined structure is pretensionable, which suggests that all strings in the structure are under tensions all the time.

The following figures represent situations when a single point load, a uniform load and gravity only are applied to the truss.





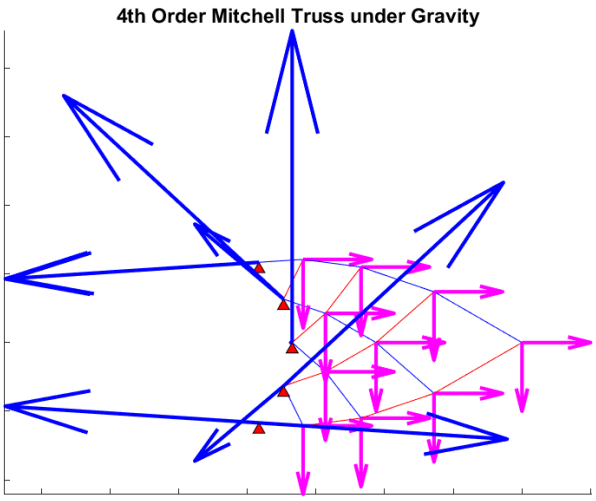


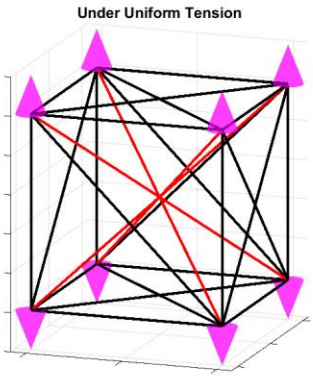
Figure 1. Truss structure under different loads. Red line represents tension and blue line represents compression.

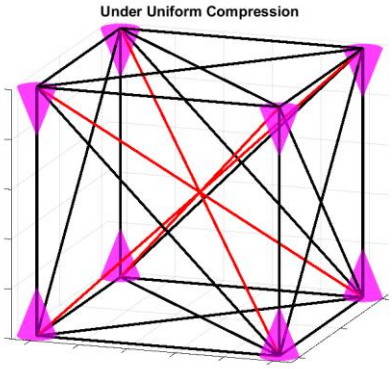
The structure is neither potentially inconsistent nor undetermined. This situation is desirable because it suggests that there is no soft mode and the structure will not largely deform under a small external disturbance. When there is only gravity acting on the structure, all bars are under compression and all strings are under tension. However, it is worth noting that for first two situations, there are some bars not under compression and some strings not under tension. Additionally, it is clear that positions and numbers of members experiencing tension and compression changes as the loading situation changes, so it is better to change numbers and positions of bars and strings according to the loading situation.

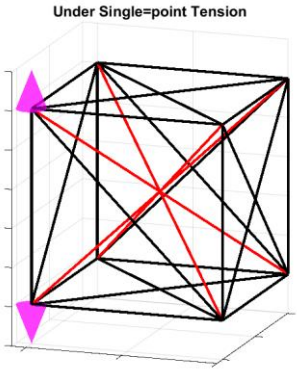
Nominal Prism

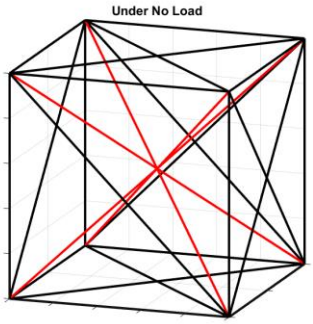
In this part, various features of a nominal prism structure are discussed.

The nominal prism structure is a tensegrity constructed by 4 bars and several strings. Because for this part, all nodes in the nominal prism are considered as free node, it is only possible to apply symmetric loading that fixes the position of the structure, as the asymmetric load will move the structure away. Following figures represent situations when there are total tensions, total compressions, single-point tension and no load acting on the structure.









In these figures, red lines represent bars and black lines represent strings. For all loading situations, the structure is potentially inconsistent, suggesting the existence of soft mode that can lead to failure. Also, the structure is underdetermined and not pretensionable in these loading situations. These results imply that some strings are not under tension and are not desirable.