Dyson Day Project Overview 2025

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Project Title: Saving The Great London Plane of Ely

This fourth year undergraduate project aims to produce a computational model of the London Plane of Ely (see the picture on the right).


Figure 1: The London Plane of Ely (Tree Council UK)

The London Plane of Ely is the tallest example of its species in the UK, and one of the oldest examples, having been planted almost 400 years ago. Since then, the tree has undergone a series of support systems, designed to keep it's large limbs from falling due to damage.

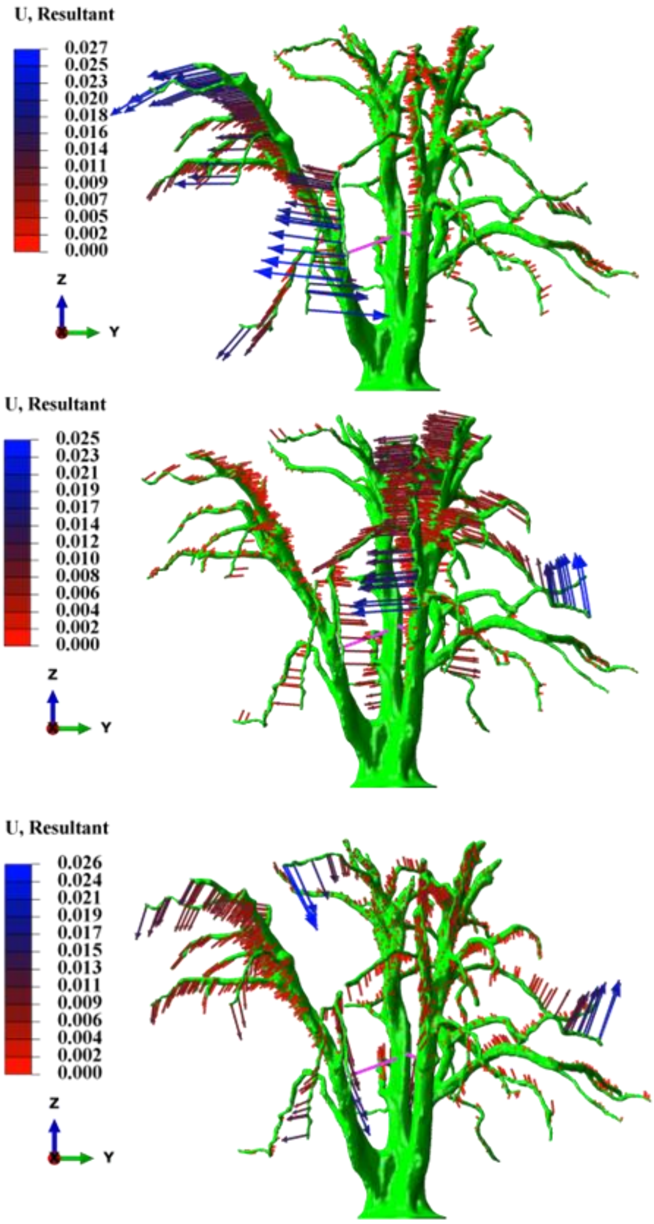
In 2024, a tree survey was performed by arborists, and identified cavity regions throughout the base of the tree, indicating that the tree could be at risk of further damage. Of particular note was that one of the primary limbs (shown on the left in Figure 1) was at particular risk. It was then decided that a new cable support system should be installed, with this project forming part of an investigation into how engineering practices may be able to better inform the design of such a cable system.

To help inform the cabling, a 3D LiDAR scan was taken, forming a computer representation of the tree in the form of a point cloud. A large portion of the project focused on attempts to accurately convert this scan into a suitable model that can used for finite element analysis (FEA).

Once the scan was converted into a finite element model (FEM), the natural frequencies of the structure can be established, and then tuned to measured accelerometer data.

In December 2024, four accelerometers were installed on the tree on different branches. This accelerometer data was used to calibrate and then validate the model, by changing the material properties of the model such that the natural frequencies match the measured peak frequency response.

From the model, three critical modes of vibration were identified, as shown in the diagram on the right. We found that these modes correspond to the motion of individual branches; in particular there was a mode almost entirely localised to motion of the critical branch.



Using this model, it was possible to simulate the effect of a cabling system on the natural frequencies of the tree, as well as the motion of the tree for specific modes of vibration.

It was found that as the stiffness of the cabling increases, the tree becomes more dynamically coupled. The degree to which this occurs could prove to be vital information for the arborists when designing the cable system, as they are able to change the cable stiffness by introducing more elasticity via springs.

The future aim of this analysis would be to tune the coupling of different branches such that the motion of the most susceptible branches is reduced, whilst maintaining a suitable range of motion to enable the tree to continue growing new wood in critical areas.