Modelling Morphogenetic Growth Patterns for Structural Reinforcement

If we stopped all emissions today, the climate would continue to warm the planet for decades to come: it is vital we implement measures for carbon sequestration. Architectural regenerative design allows us to leverage the natural carbon sequestration properties of plant life, along with structural security and biodiversity gains. Until recently, we have struggled to model the seemingly random nature of biological growth, but advances in machine learning and morphogenetic programming have allowed us to identify the governing equations to accurately model these growth patterns. This project aims to assess the utility of biological restoration measures in various construction and retrofit applications, in both urban and rural environments, modelling these structures and simulating their responses over time considering environmental factors.

# Project Components

* Identify scenarios in which biologically assisted reinforcement offers key benefits compared with conventional measures
* Identify the underlying relationships between conditions and growth patterns for a variety of plant species that might be applicable
* Assess the use of generative programming to model structures compared with machine learning relationships between on spatial point clouds
* Test the relative strength of these structures through means of Finite Element Analysis to draw key comparisons
* Rerun simulations and test against real world samples to establish uncertainty values

## Optional Further Developments

* Create a platform for architects to upload structures and easily model different growth patterns to evaluate the impact of biological restoration measures
* Analyse the success of predicting plant growth through morphogenetic programming compared with point cloud generation and machine learning processes
* Model the morphogenetic interactions between multiple plant species

<https://greenlab.cirad.fr/StemGL/>

<https://www.nature.com/articles/s41598-024-62147-3>