Botanical Biomimicry: Using Genetic Algorithms and Plant Phyllotaxy to Determine Optimum-Efficiency Solar Arrays

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With the ever-increasing popularity of renewable energy, many are beginning to explore the possibility of using solar arrays in domestic and/or compact, urban environments. For the average property owner, however, placement of solar arrays can be inconvenient due to the large base surface area required to mount traditional flat PV panels. Therefore, as prices to manufacture and install these arrays plummet drastically, researchers must begin to consider exploring more complex, nontraditional orientations of solar cells that could prove to be more efficient than the classic flat solar panel. A program was created to model and generate digital blueprints for these space-efficient arrays by harnessing the sunlight-collecting power of natural plant growth structures. The program utilizes genetic algorithms to mimic the phyllotaxy of plants in making these arrays, as plants are the preeminent natural example of how to best collect sunlight given limited material and space. After developing the program and running through numerous generations in the genetic algorithm, the generated solar arrays (in the shape of digital plants) overall demonstrated a greater efficiency (i.e. a higher average fitness determined by the program's fitness algorithm) than typical flat solar arrays that occupied the same base area. This paper focuses on the development of the digital plant environment as well as the process of building and executing the genetic algorithms to search for optimum-efficiency plants.

Awards Won:

Fourth Award of $500