What is a Genetic Algorithm (GA)?

“A GA is a method for solving [...] optimization problems that is based on natural selection, the process that drives biological evolution.

The GA repeatedly modifies a population of individual solutions. At each step, the genetic algorithm selects individuals from the current population to be parents and uses them to produce the children for the next generation. Over successive generations, the population "evolves" toward an optimal solution.

You can apply a GA to solve a variety of optimization problems that are not well suited for standard optimization algorithms, including problems in which the objective function is discontinuous, nondifferentiable, stochastic, or highly nonlinear.

The GA uses three main types of rules at each step to create the next generation from the current population:

- Selection [...]
- Crossover [...]
- Mutation [...]”

https://uk.mathworks.com/help/gads/what-is-the-genetic-algorithm.html?s_tid=gn_loc_drop

Can I solve my problem with a GA? You will need:

1. a **“genetic” representation** of the solution domain, aka “chromosome”, with which you must be able to do the “mutation” and “crossover” operations
2. a **fitness function** to evaluate the solution domain

- If you sort both, you can run a GA!

Fitness function

a) Calculated through formula (may involve simulation), or

b) Human judgment (interactive GA)

Crossover

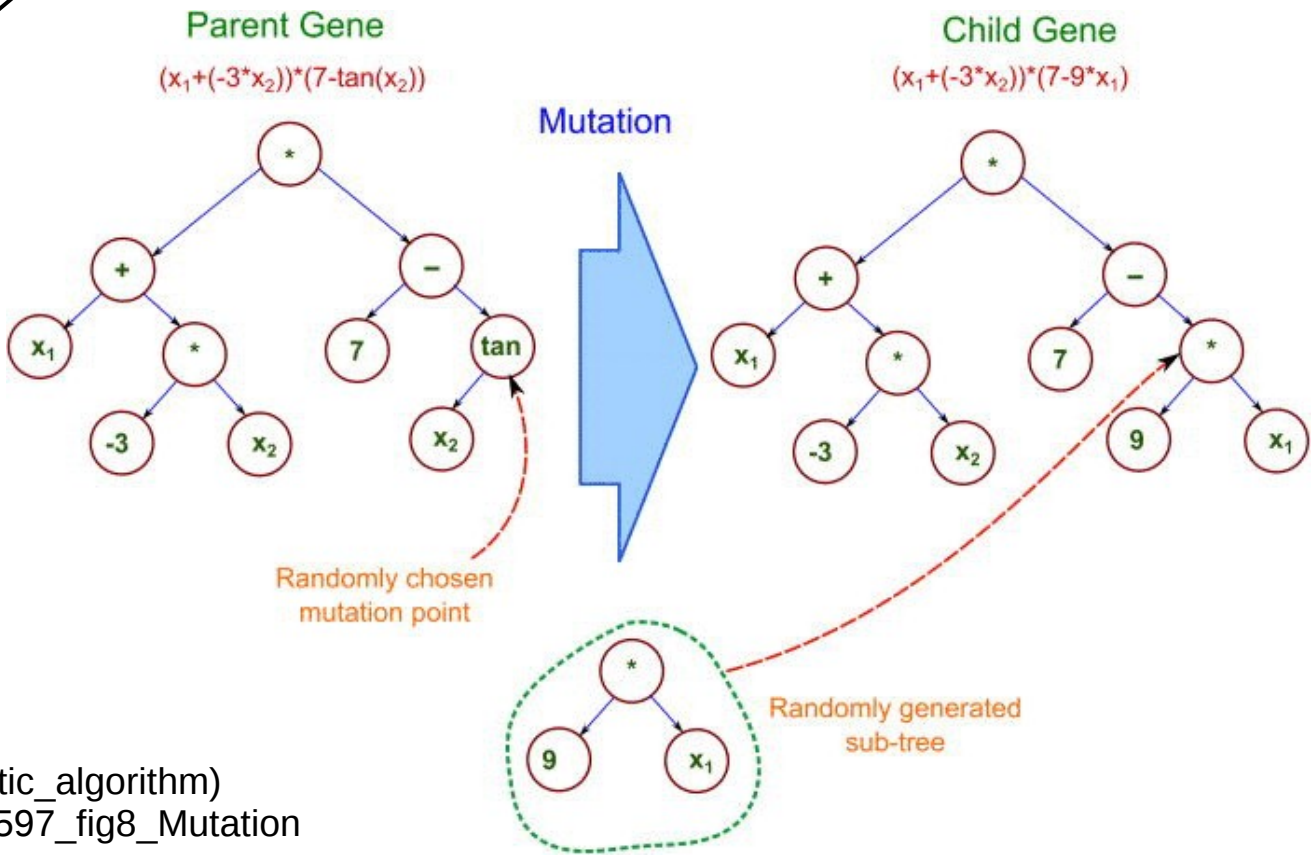
https://en.wikipedia.org/wiki/Crossover_(genetic_algorithm)

Mutation

1 0 1 0 0 1 0

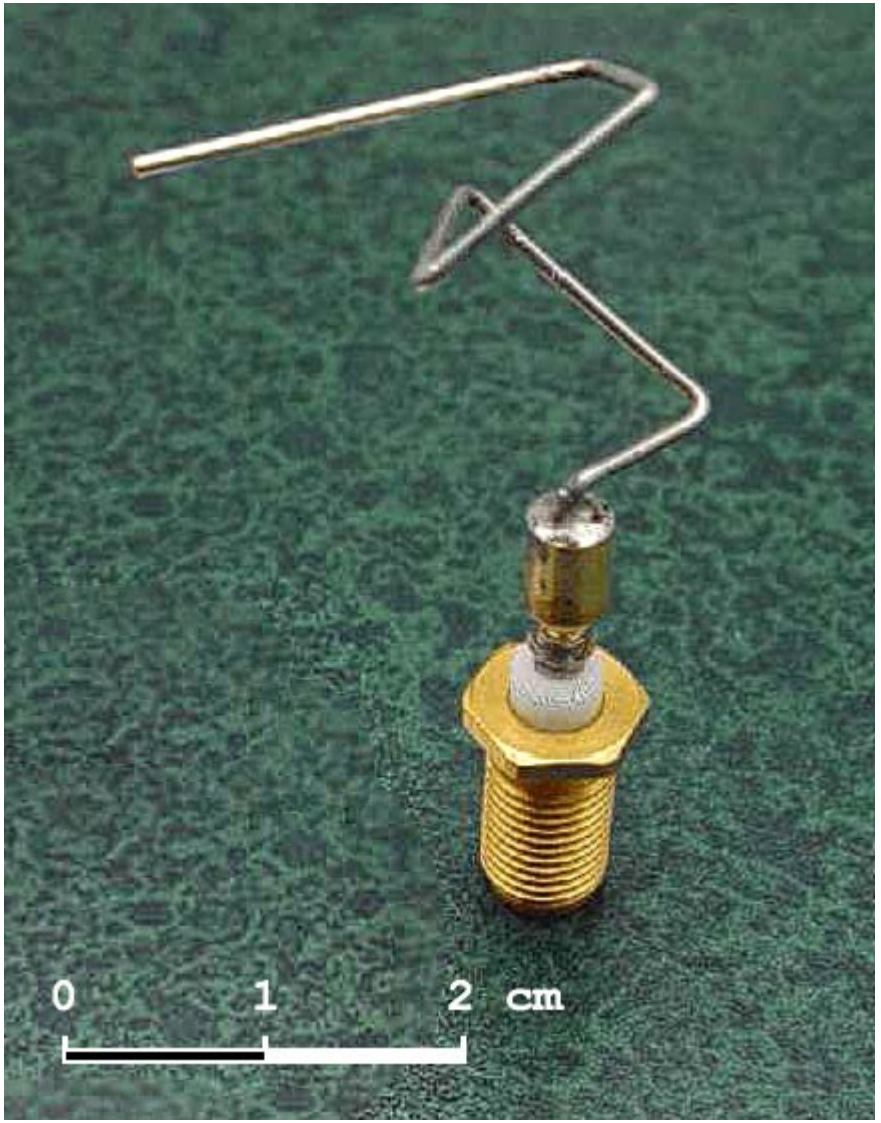
↓

1 0 1 0 1 1 0



https://en.wikipedia.org/wiki/Mutation_(genetic_algorithm)
https://www.researchgate.net/figure/260519597_fig8_Mutation-operation-in-Genetic-Programming

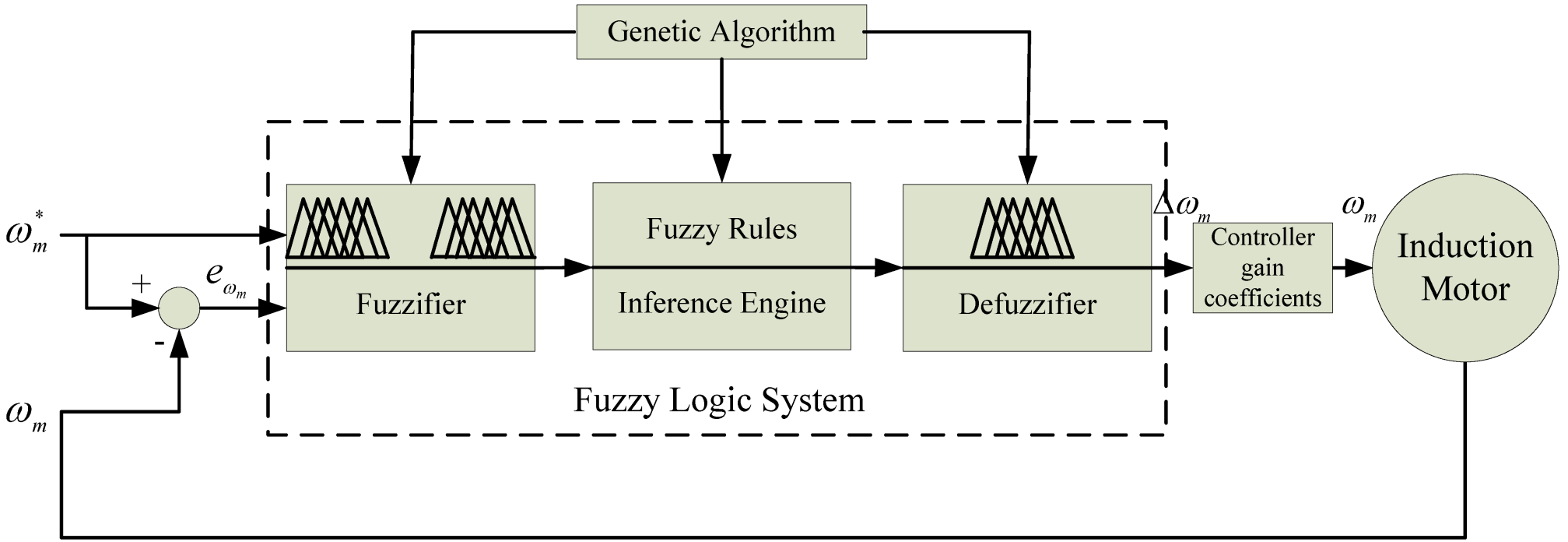
Examples



“2006 NASA ST5 spacecraft antenna”

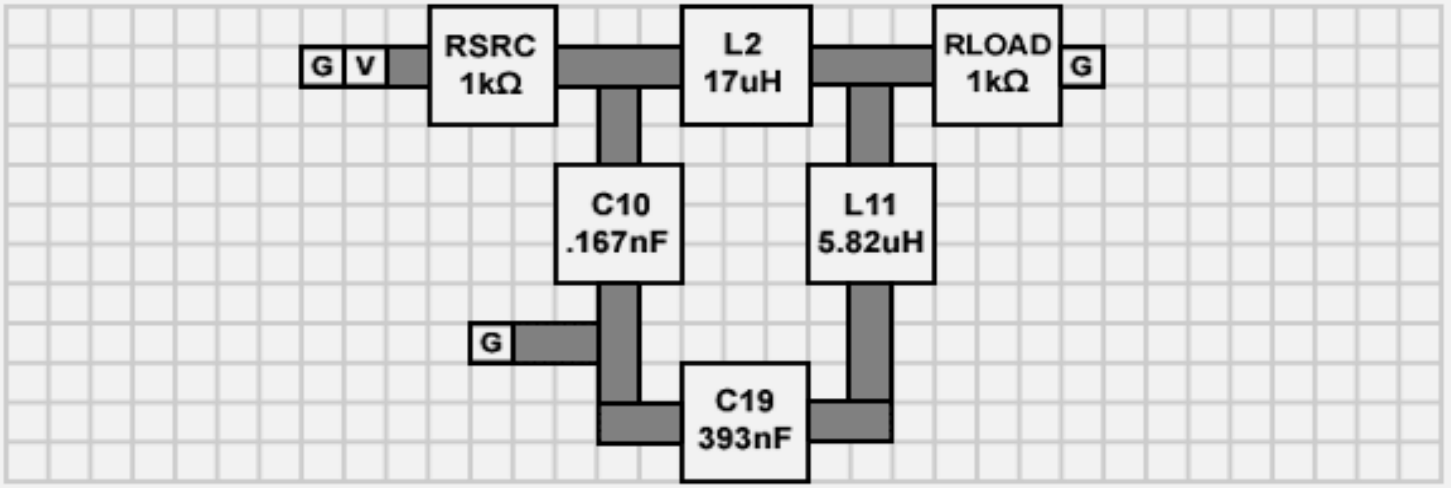
(https://upload.wikimedia.org/wikipedia/commons/f/ff/St_5-xband-antenna.jpg)

Examples

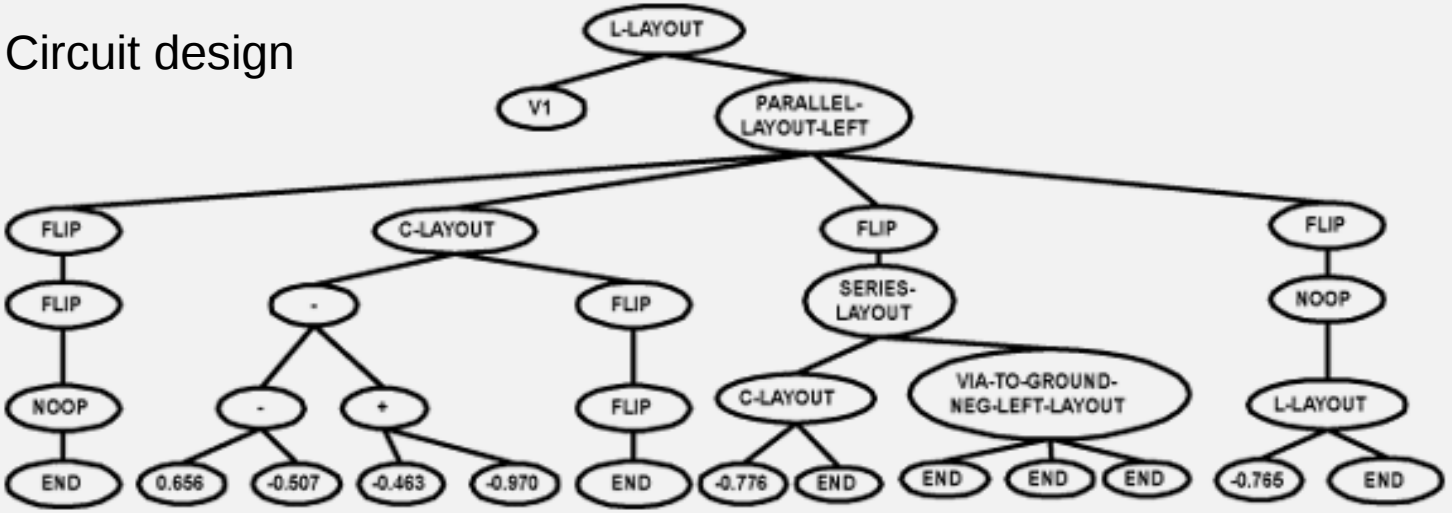


https://www.intechopen.com/books/induction-motors-applications-control-and-fault-diagnostics/an-optimized-hybrid-fuzzy-fuzzy-controller-for-pwm-driven-variable-speed-drives

Examples

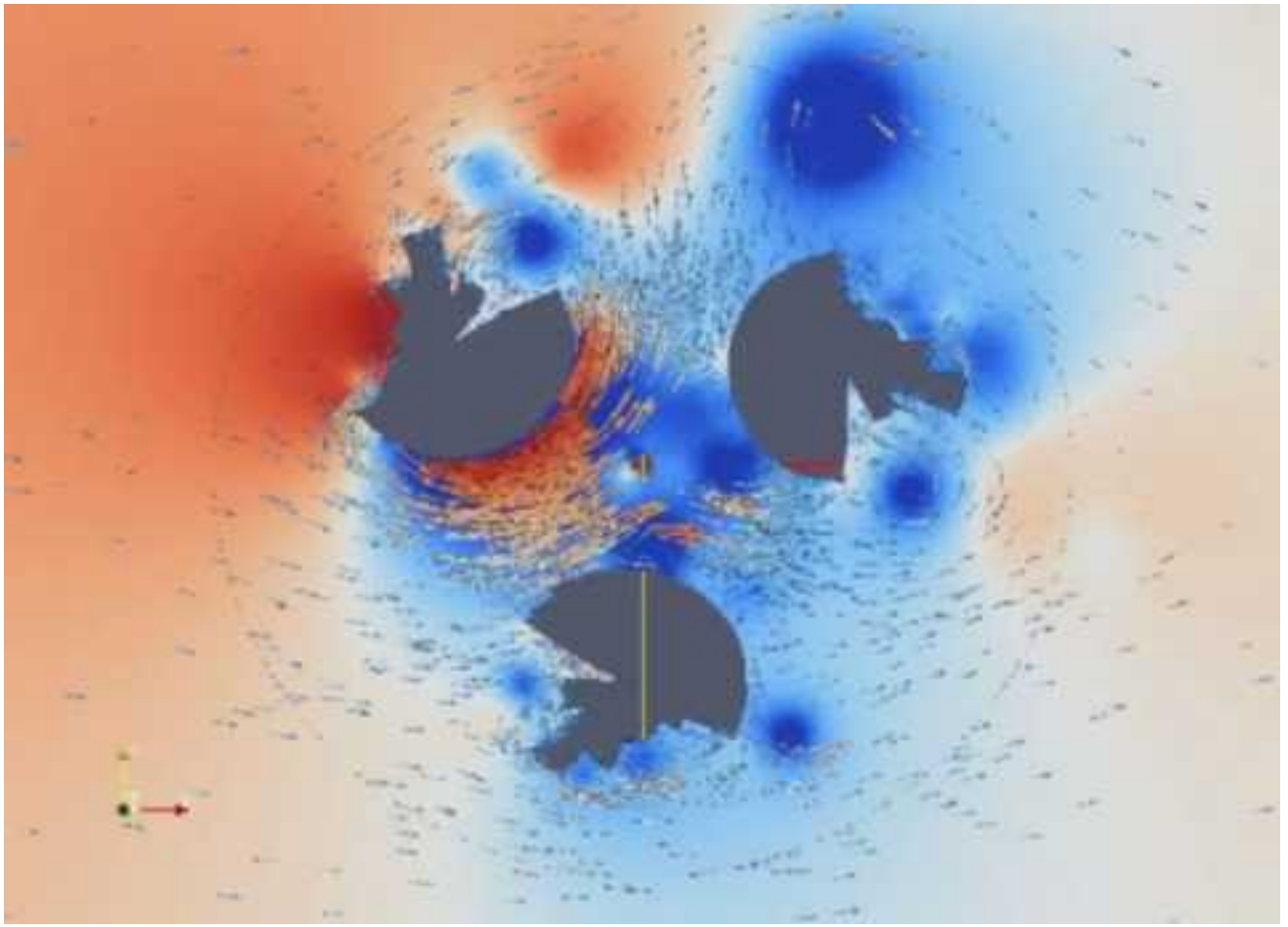


Circuit design



https://www.cp.eng.chula.ac.th/~piak/talk/2013/ga-tutorial/gp/gplayoutanimation.gif

Examples



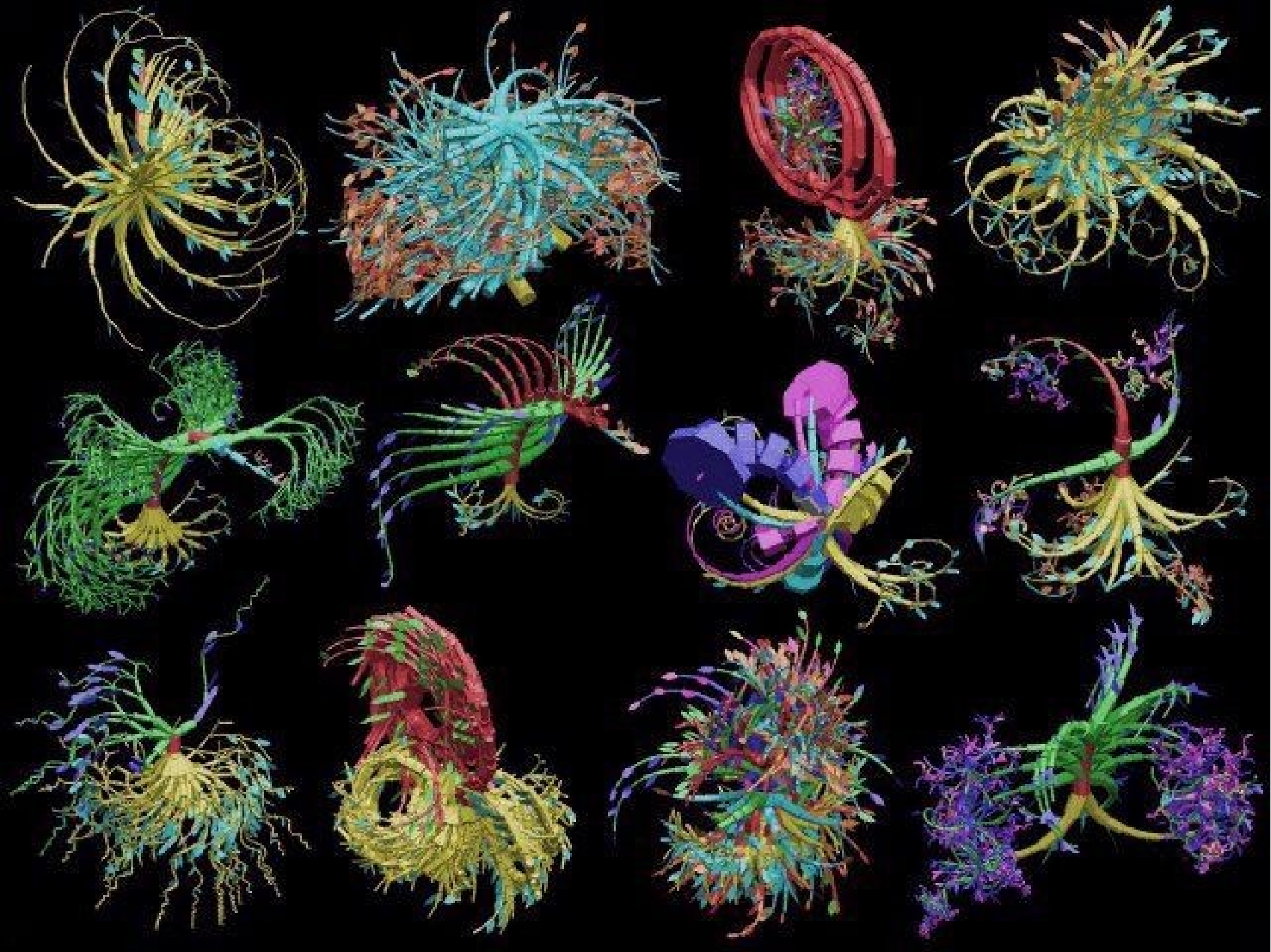
Wind turbine blades

https://www.youtube.com/watch?v=YZUNRmwoijw

Examples



https://notnot.home.xs4all.nl/breed/Breed.html



Summary: keywords

- Chromosome
- Fitness function
- Mutation
- Crossover
- Population
- Generation
- Parents
- Children