Searching the Crystallisation Parameter Space using Evolutionary Algorithms

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When trying to crystallize a new protein, the researcher usually explores a multi-dimensional parameter space using a sparse-matrix or other type of screen. Frequently, the results of such a search consist in a small number of 'promising' conditions. The researcher then conducts a finer mesh search, centered at each of the 'promising' points of the parameter space. If this fails to produce diffracting crystals, other screening conditions must be thought up.

We propose the further probing of such 'promising' conditions, using small-scale Evolutionary (Darwinian) Optimisation Algorithms. Each promising condition is pictured as a 'chromosome', the values of the various parameters (type of precipitant, buffer, pH, temperature, ...) being the alleles on that chromosome. The original 'promising' conditions of the screen constitute a 'first generation' of experiments. A second generation is constituted by random 'recombination' of these 'alleles', i.e. by combining successful values of parameters from different conditions. The most successful of the second generation of experiments will in turn be the 'parent conditions' of a third generation. 'Mutations', i.e. as yet untried values of parameters, can be sparsely introduced in each generation.

This method will not be as robust as for the purely computational optimisation problems for which it is normally used, due to the limitations on the number of 'generations'. It can however lead to optimal combinations of parameters, provided judicious choice of the conditions that will be the parents to each successive generation.

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