SFB 680
Molecular Basis of
Evolutionary Innovations

SPP1590
Probabilistic Structures in Evolution

Monday, May 6, 2013 at 16.00 h
Biocentre, Ground floor lecture hall

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On the existence of accessible paths in various models of fitness landscapes

We present rigorous analyses of a number of well-known mathematical models for genetic mutations. In these models, the genome is represented by a vertex of the n-dimensional binary hypercube, for some n, a mutation involves the flipping of a single bit, and each vertex is assigned a real number, called its fitness, according to some rules. The study of such models has a long tradition, both in mathematical biology and in statistical physics, where the same models arise in the study of spin glasses. The field has been recently galvanised by the increasing availability of empirical genetic data. In this context, Weinreich and others introduced the notion of an accessible evolutionary pathway, that is a path along which fitness is monotonically increasing or, in the case of spin glasses, along which energy is monotonically decreasing. Our main results resolve open questions about three such models, which in the biophysics literature are known as House of Cards (HoC), Constrained House of Cards (CHoC) and Rough Mount Fuji (RMF). We prove that the probability of there being at least one accessible path across the directed n-hypercube tends, in the case of HoC and CHoC respectively, to 0 and 1, as n tends to infinity. In the case of RMF, we prove that the probability of accessible paths existing tends to 1 for a wide class of underlying fitness distributions.

Host: Joachim Krug