[Talk 25] Genotypic complexity of Fisher's geometric model

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Fisher's geometric model (FGM) is a simple fitness landscape model in which an organism is characterized by *n* phenotypic traits and mutations are random displacements in the trait space. The fitness is given by a smooth and single-peaked function around the optimal combination of phenotypes. Recently, Blanquart *et al*. (2014)† introduced an ensemble of genotypic fitness landscapes constructed from FGM by considering an additional genotypic sequence space where each locus represents the presence or absence of a certain mutation. Additionally, they assume that the displacements corresponding to the mutations are vectorially combined. This model is particularly interesting because it presents a natural connection between genotypes and phenotypes, and their interplay produces a nontrivial functional dependence of the structure of the resulting genotypic fitness landscape on phenotypic parameters. To provide a solid understanding of the mechanisms by which ruggedness emerges in such landscapes, we are mainly concerned with calculating various ruggedness measures analytically by establishing a spin glass representation analogous to the Hopfield model, a fundamental model of neural networks. By interpreting the genotypic dimension as the network capacity, these results are compared with the metastability measures of the Hopefield model. Surprisingly, from the results on the different measures, we consistently find that the induced landscapes become less rugged with increasing phenotypic dimension *n*. Finally, we discuss the biological implications of our analytical results.

† Blanquart, F., G. Achaz, T. Bataillon, and O. Tenaillon, Evolution **68**, 3537 (2014).