

Rate4Site: An Algorithmic Tool for the Identification of Functional Regions in Proteins by Surface Mapping of Evolutionary Determinants within their Homologues

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Motivation: A number of proteins of known three-dimensional (3D) structure exist, with yet unknown function. In light of the recent progress in structure determination methodology, this number is likely to increase rapidly. A novel method is presented here: "Rate4Site", which maps the rate of evolution among homologous proteins onto the molecular surface of one of the homologues whose 3D-structure is known. Functionally important regions correspond to surface patches of slowly evolving residues.

Results: Rate4Site estimates the rate of evolution of amino acid sites using the maximum likelihood (ML) principle. The ML estimate of the rates considers the topology and branch lengths of the phylogenetic tree, as well as the underlying stochastic process. To demonstrate its potency, we study the Src SH2 domain. Like previously established methods, Rate4Site detected the SH2 peptide-binding groove. Interestingly, it also detected inter-domain interactions between the SH2 domain and the rest of the Src protein that other methods failed to detect.

Supplementary Information: multiple sequence alignment of homologous domains from the SH2 protein family, the corresponding phylogenetic tree and additional examples are available at http://ashtoret.tau.ac.il/~rebell

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