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A signal matching algorithm based on Dynamic Time Warping

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Signal matching is a necessary part of many geological disciplines such as paleoclimatology, sedimentology and marine geology. Tuning a paleoclimatic signal to a target curve, driven by variations in the astronomical ("Milankovitch") parameters, is a powerful technique to construct accurate time scales. However, this method can be rather time-consuming. Therefore, different approaches to automate the process have been developed: from 'naive' cross-correlations to more sophisticated ones based on the ideas of dynamic programming, see e.g. [1].

We introduce an algorithm based on 'Dynamic Time Warping' [2]. Dynamic time warping aligns two sequences of patterns given constraints on absolute ages (radio-isotopic or stratigraphic), sedimentation rates and measures of fit. Stemmed from the voice recognition task, it cannot be applied to geological data in its traditional form without degradation of signals. Thus, a single element of one sequence may be assigned to many consecutive elements of the other one, leading in geological terms to zero and infinite sedimentation rates. We develop an algorithm avoiding such drawbacks at the expense of additional specific 'global' and 'local' constrains driven by reliable sedimentation rates. The method can be used not only to facilitate astrochronological tuning, but also for more general sedimentologic cross-correlation problems. The algorithm is implemented as a computer program with a graphical user interface using Free Pascal and Lazarus IDE and available both for Windows and Mac OS. Examples with synthetic and real data are demonstrated.

References:

[1] Lisiecki L E and Lisiecki P A (2002) Paleoceanography 17. PA1049.

[2] Pälike H (2002) in: *Extending the astronomical calibration of the Geological Time Scale*, PhD thesis, University of Cambridge.