Deconvolution of continuous paleomagnetic data from pass-through magnetometer: A new algorithm with ABIC minimization

Hirokuni Oda[1]; Chuang Xuan[2]
[1] IGG, GSJ, AIST; [2] National Oceanography Centre Southampton

The development of pass-through superconducting rock magnetometers (SRM) has greatly improved our efficiency in collecting paleomagnetic data from continuous long-core samples. The output of pass-through measurement is the convolution of magnetization of a continuous sample with the magnetometer sensor response, which introduces smoothing and distortion to the paleomagnetic signal. Although previous studies have demonstrated that deconvolution can effectively restore high-resolution paleomagnetic signal from pass-through measurement, difficulties in accurately measuring the magnetometer sensor response have hindered the application of deconvolution. We acquired reliable sensor response of an SRM at the Oregon State University (OSU) based on repeated measurements of a precisely fabricated magnetic point source. In addition, previous deconvolution studies did not consider the effects of inaccuracy in sample length and measurement position. We present an improved algorithm of deconvolution incorporating new parameters 'position shift' and 'length correction' along with Akaike's Bayesian Information Criterion (ABIC) minimization of Oda and Shibuya [1996]. The new algorithm was tested using synthetic measurement data constructed by convolving 'true' paleomagnetic signal containing a geomagnetic excursion with the sensor response. Realistic noise was added to the synthetic measurement using Monte Carlo method based on measurement noise distribution in relation to gradient of magnetic moment, acquired from 200 repeated measurements of a u-channel sample. Deconvolution of 1000 synthetic measurements with realistic noise closely resembles the 'true' magnetization, and successfully restores fine-scale magnetization variations including excursion with errors and residuals mostly in the predicted range. Our analyses also show that inaccuracy in sample length and measurement position significantly affects deconvolution results, and can be accounted for using the new optimized deconvolution algorithm. Optimized deconvolution of 20 repeated measurements of a u-channel sample yielded highly consistent deconvolution results and estimates of optimized 'position shift' and 'length correction', demonstrating the reliability of the new deconvolution algorithm for real pass-through measurements.