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Poster
Ground-based magnetic data are critical to space physics and geomagnetic observatory research. However, the quality of the recorded data is often affected by various external factors, including localized disturbances, weather conditions, and instrument noise. Signal enhancement techniques like normalized least mean squares adaptive filtering (NLMS) can be used to improve the data quality. We have developed a new algorithm integrating scalar and vector magnetometer data into an NLMS filter to enhance the signal-to-noise ratio significantly. Our new algorithm estimates the signals' correlation to determine the filter coefficients that can minimize the error between noisy and reference signals. By adjusting the filter weights based on the correlation estimate, NLMS removes uncorrelated noise and improves the signal quality of the noisy magnetometer. Our test setup includes five vector magnetometers aligned to true north and one scalar magnetometer. The five vector magnetometers are arranged in proximity so that the predominant uncorrelated noise between the sensors is inferred as instrument, and very localized, noise. We compare three different combinations of scalar and vector magnetometers simultaneously, where one magnetometer is the control, and the other two are test magnetometers for NLMS. We calculate the power spectral density of each dataset to analyze the noise floor and compare the normalized data's signal-to-noise ratio to assess the best noise reduction performance. The result is a significant improvement to noise reduction and removal from magnetometer data, making NLMS a powerful tool for signal enhancement of ground-based magnetometer data.

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