OVER WHAT BANDWIDTH SHOULD AN EMG SIGNAL BE WHITENED?


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AIM: Most surface EMG electrode systems have a passband out to 400–600 Hz. In contrast, many studies of EMG signal whitening have used custom wideband electrode systems, and have whitened the EMG signal out to 1000–2000 Hz. We systematically investigated the performance of EMG whitening as a function of maximum available signal frequency. Whitening decorrelates the EMG signal and has been shown to be advantageous in EMG-force processing and EMG amplitude estimation.

METHODS: Previously collected EMG data from 54 healthy subjects were reanalyzed. Two constant-posture contraction types were studied. First, EMG-force processing was studied utilizing low-level, torque-varying contractions which averaged 18.5 %MVC$_F$ (percent flexion MVC). Second, EMG amplitude estimation was studied utilizing medium-level, constant-torque contractions (50% MVC). Both analyses assessed performance vs. the frequency band over which whitening was performed.

RESULTS: For the low-level, torque-varying contractions (effort levels consistent with most daily tasks), EMG-force performance utilizing frequencies out to 400–500 Hz did not differ significantly (p<0.01) from utilization of the full 2000 Hz bandwidth. For the medium-level 50% MVC contractions, performance utilizing frequencies out to 800–900 Hz did not differ significantly from utilization of the full bandwidth.

CONCLUSION: Conventional electrode systems with bandwidths out to ~500 Hz provide all of the whitening benefits of wider band systems for the lower-level contractions of typical daily effort. Wider band systems are advantageous for more strenuous activities. Lower noise EMG acquisition systems may also take advantage of higher signal frequencies.

REFERENCE: Dasog et al., Electromyogram Bandwidth Requirements When the Signal is Whitened. IEEE Trans Neural Sys Rehab Eng, in press.

![Figure 1](image_url)

**Figure 1:** Left: EMG-torque error vs. whitening bandwidth for linear and nonlinear dynamic models. Right: EMG amplitude estimation SNR from 50% MVC trials vs. whitening bandwidth.