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Vibrating-String Coupling Estimation from Recorded Tones

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Coupling of vibrational polarizations in a single string, for an instrument such as the acoustic guitar, produces psychoacoustically significant effects such as beating and two-stage decay (Weinreich, JASA v62 n6). Previous considerations of string coupling phenomena appear not to have addressed the practical problem of calibrating computational models based on recorded tones. In this work, we take a data-driven approach using measured data from a vibrating string from an acoustic guitar, the motion of the string in two orthogonal planes, and formulate a regularized least-squares problem for computing the coupling between the measurements. Such a formulation ensures that the resulting coupling is physically admissible, in that the resulting coupling factors do not generate energy, and are easily found as the problem is convex. Well-studied algorithms for solving convex problems, such as interior-point and gradient descent methods can be used and are widely available in the form of open-source libraries.