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### Empirical articulatory-acoustic relations for vowels

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Vowels tokens were extracted from four talkers in the Wisconsin X-ray Microbeam Speech Production Database. The neighboring phonemes of these vowels were restricted to be non-nasal and non-liquid. The first three formant frequencies were measured using LPC analysis with manual corrections at a rate corresponding to the pellet trajectory sampling rate, thus yielding large amounts of simultaneous formant frequency and pellet position data points (between 11,000 and 20,000 for each talker.) Principal components analysis was performed for both the formant frequencies and the pellet position data, to produce three orthogonal acoustic components and four orthogonal articulatory components. A local linear regression technique, known as loess [Cleveland, W. S. and Devlin, S. J. (1988), /J. Amer. Stat. Assoc., 83/, 596 - 610], was applied to orthogonal components to map between the acoustic and articulatory domains. This technique permits regression slopes to vary within the domain of the independent variables. The results will be discussed in terms of optimization of loess parameters (e.g. size of local neighborhoods), goodness of fit of the mappings, and the degree to which slopes in the mappings vary. Manually corrected formant frequencies will be compared with fully automatic Line Spectral Frequencies. [Supported by NIDCD-001247 to CRéSS LLC]