

Motif-Gesture Clustering in Karnatak Vocal Performance: A Multimodal Computational Music Analysis

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Introduction

As music is increasingly understood as multimodal rather than purely sonic, there has been a growth in research on co-singing bodily movement. In Indian art music contexts, connections have been noted between bodily gestures and musical motifs (Rahaim 2012), but systematic analyses remain scarce. Here we draw on co-speech gesture studies where catchments have been theorized as regions of recurring gestures that index underlying discourse themes (McNeill 2000; Pouw and Dixon 2020). We analyze a dataset of 5.42 hours of Karnatak (South Indian) vocal performances (audio, video, motion-capture), investigating how performer gestures (hand movements) correspond with short musical structures known as *sañcāras* or motifs. Such units are musically meaningful in Karnatak music, acting as building blocks of compositions and extemporizations (Viswanathan 1977). We assess our dataset for gestural catchments, seeking to discover whether either gestural spatial trajectory or acceleration are most reliably connected with musical motifs. We do this to understand how co-singing gestures index musically meaningful units.

Methods

We use a machine learning methodology tailored for Karnatak music to locate regions of repeated melodic patterns across the dataset (Nuttall et al. 2022). The dynamic time warping (DTW) distance between audio features (f_0 , Δf_0 , loudness, spectral flux) and gesture (3d position, acceleration and velocity of hand motion) event trajectories are computed for each pairwise combination of regions. To assess whether acoustic motifs covary with spatiotemporal patterns of gesture we compare distances corresponding to gesture events with distances corresponding to pitch events. Gesture trajectories are examined in three-dimensions (vectors) and also as magnitude traces (scalars), to abstract away from spatial properties and instead index the production of forces in any direction (Pearson and Pouw 2022). In addition, we create an interactive visualization to further explore gesture-motif relationships.

Results

Using dynamic visualizations (<https://tsg-131-174-75-200.hosting.ru.nl/karnatak/>), we qualitatively observe that some reoccurring motifs show reoccurring gesture structure. The analyses in our DTW distance covariance tests are still in progress and will be reported at the conference.

Discussion and conclusion

Initial exploratory analyses suggest that there is a weak to moderate trend for motifs that have similar f_0 movement to co-occur with similar gestural movements. Further in-depth analyses will be completed by the conference date, using data scientific methods to explore the exact kinematic and vocal features that correlate and support qualitative observations that some motifs that sound alike co-occur with gestures that move alike.

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