An approach to adding knowledge constraints by fractal analysis on a generative model of Carnatic rhythm sequence

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Abstract

The term 'improvisation' has been used in various contexts in the literature in regard to music performance, especially for those repertoires that have no prescribed score such as Indian music. Literature in non-Eurogenetic music constitutes some of the earlier examples in the area of culture-specific music technologies. Previous studies [1,2] from the Music and Sound Cultures (MaSC)[1] research group had the goal to develop expert systems that can reliably generate music in this style of South Indian (Carnatic) rhythm sequences. The latest version of CaMel [3] targeted to get rid of the drawback of the former model(s) being a failure to capture long-term structure and grammar of this particular idiom and being only successful in capturing local and short-term phrasing. We base our current work on the hypothesis that improvisation is highly structured, and can be modeled as a dynamic interaction between certain predictable patterns (possibly retrieved from the performer's mental 'schema') and some unpredictable gestures that are regarded as 'expressiveness'. Fractal geometry is often a way to go to model these interactions [4-7]. Fractal rhythms, in specific, involve complex dynamics of self-organizing that are visible at various levels of analysis by zooming-in or -out, and tracing the pattern changes over time. Because music is based on 'repetition' of 'beats', it is said that 'what' the next musical event will be is not always easy to guess, but 'when' it is likely to happen can be easily predicted. A professional Carnatic percussionist Akshay Anantapadmanabhan recorded the audio material representing demonstrative compositions on a Mridangam, along with the konokkol (vocables). The current study analyzes rhythmic patterns at different time-scales using both time- and frequency-domain features, including wavelet transforms that are well-known for multiresolution analysis to find self-similarity in time-space. Observation on a self-similarity matrix reveals block structures replete with self-similar substructures that indicate the fractal nature of the onset patterns. Initial results suggest that the deviations in beat intensity and duration contribute to the multifractality. We aim to resolve some of the past issues with CaMel by adding the experimental outcomes as 'knowledge constraints' and hoping the generated sequences to sound 'semantically plausible' conforming to musicians' expectancy.

Keywords: Fractal modeling, Carnatic rhythm, Generative model, Improvisation.

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