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Complexity and Fractal Patterns in Music

Beginning in the early Renaissance, mathematical transformations of melodic lines became a common musical practice and many composers constructed their pieces according to deliberate structural principles. The prolation canon, whereby a number of simultaneous voices follow the same melody but each at a different tempo, became a tour de force in mid 15-th century and remained popular through the Baroque era. In the following centuries, other complexities, often deriving from rhythmic shifts or daring pitch variations, have been introduced by composers. While a variety of statistical tools have been proposed to analyze time series in sound, they entail averaging over entire movements which is problematic. This talk offers a new, direct measure of structural complexity based on the tonal and rhythmic variations of the defining motifs, and therefore sensitive to local articulations. For multi-scale patterns in music, such as prolation canons, the tonal and rhythmic aspects are separately reflected in the corresponding fractal indexes. The proposed concepts are tested on "synthetic" examples and then illustrated with a number of masterful compositions spanning five centuries of music making.

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