Tonal harmony, the topology of dynamical score networks and the Chinese postman problem[#]

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Abstract: We introduce the concept of dynamical score networks for the representation and analysis of tonal compositions: a score is interpreted as a dynamical network where every chord is a node and each progression links successive chords. We demonstrate that this network displays scale-free properties, and centrality, as a representation of preferential attachment and growth, is intrinsic to this concept. All the characteristics of tonality come into play here: the most obvious, centricity, coincides with the existence of chord hubs, so that highest degree nodes can be assigned to the most prevalent chords (tonic, dominant, etc.) according to one of the numerous fitness models, functionality scores, or degree distributions in existing corpora. In this framework, optimal chord progressions can be found by solving for a minimal length path like in the Chinese postman problem. Moreover, the dynamical network can be viewed as a time series of a non-stationary signal and as such can be partitioned for the automatic identification of key regions using well-established techniques for time series analysis and change point detection. Based on this interpretation, we introduce a key-finding algorithm that does not rely on comparisons with pre-determined reference sets or extensive corpora but is firmly based on the degree centrality concept. Finally, we show how the principles discussed in this work can be used to design a generative model of tonal compositional design (see Figure).
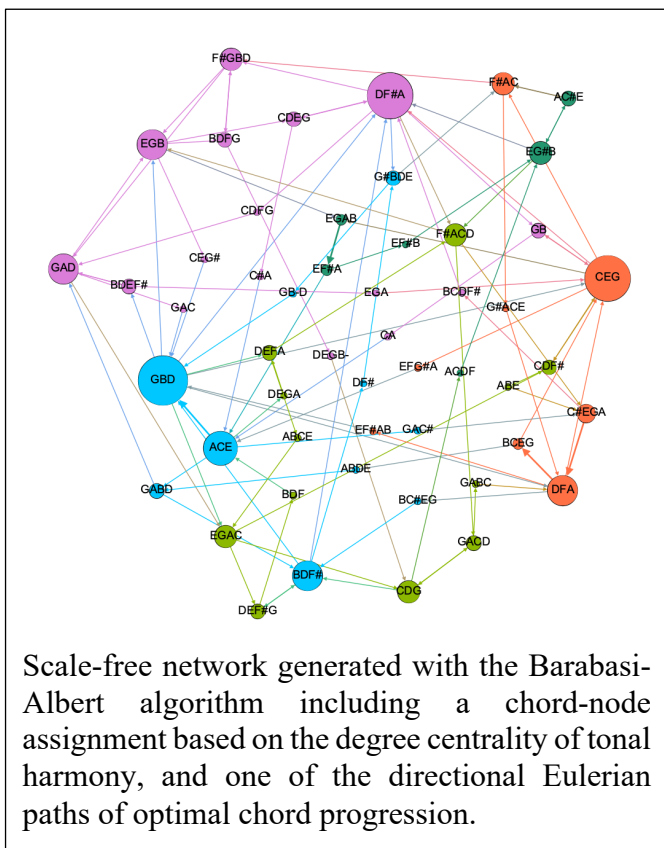
Scale-free network generated with the Barabasi-Albert algorithm including a chord-node assignment based on the degree centrality of tonal harmony, and one of the directional Eulerian paths of optimal chord progression.

[#] In a talk submitted to the main NetSci2020 conference (Network Topology of Generalized Musical Spaces) I will discuss, if accepted, the generalities of the network representations for general musical objects (pitch, rhythm, and timbre). As such, the presentation does not overlap at all with the topic of the present talk but merely provides the theoretical foundations. See also: https://arxiv.org/abs/2006.01033 and https://arxiv.org/abs/1905.01842.