

## **GRAPH REPRESENTATION OF TONAL MODULATION**

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This study approaches music theory from a graph theory perspective. Tonal Modulation, the musical process of changing the key, can be represented by a simple graph on the musical keys. This graph is called the tonal modulation graph. The primary objective of this study is to construct tonal modulation Graphs using graph theory techniques, investigating modulation possibilities within musical compositions and creating pathways between keys. The study aims to provide composers with a tool to navigate and map tonal modulation in their works. Two main types of modulation were considered: pivot modulation, involving common chords for smooth transitions, and direct modulation, characterized by abrupt key changes without intermediary chords. By applying graph coloring techniques, we can derive direct modulation graphs from pivot modulation graphs, enabling composers to experiment with distinctive key transitions. The results show a comprehensive mapping of musical keys and their interrelations, which can systematically explore all possibilities of modulation. Furthermore, the project extends its analysis to real-world music compositions, exploring modulation patterns in songs by iconic music bands such as Beatles and One Direction which connects theoretical modulation graphs to practical applications in music composition, showing the graph-based techniques' applicability in understanding musical composition. In conclusion, the study not only presents a mathematical framework for understanding tonal modulation but also offers composers with a creative tool to navigate through various modulation possibilities to enrich their musical compositions. The study highlighted the cooperation between music theory and graph theory, offering a structured framework for analyzing and composing music through the lens of graph representations of tonal modulation. The graphs discussed here maps out all the possible paths from one key to another. When modulating composers can use these graphs to find the destination key, by simply tracing a path from the initial key to the destination key. Through pivot and direct modulation graphs, the study uncovers various ways for composers to modulate between keys, unlocking new musical exploration and innovation in composition.

***Keywords:*** *Graph coloring, Modulation graphs, Tonal Modulation.*