Formulating Musical Expression

Christopher Raphael
School of Informatics and Computing
Indiana University
craphael@indiana.edu

For several decades my research group has targeted musical accompaniment systems as a grand challenge that melds score following, machine learning, and real-time interaction, into an application of significant interest in the musical community at Indiana University's Jacobs School of Music. In this work we replicate the experience of a "classical" musical soloist in a concerto-like setting, in which the soloist *leads* a performance with appropriate musical expression, as followed and supported by the orchestra. For the past several years we have performed "Informatics Philharmonic" concerts with the IU Summer String Academy, giving students a taste of this unique experience. An illuminating example at `http://music.informatics.indiana.edu/~craphael/info_phil/info_phil_2012/Maria_RC.mp4` superimposes our system's real-time thought processes over the video performance, while `http://music.informatics.indiana.edu/~craphael/info_phil` gives many other examples. The application has gained acceptance as a regular attraction in the String Academy lineup.

The Info Phil finds a sweet spot by identifying an application that is important to classical musicians, while posing a scientifically tractable solution. Fundamental to our approach is the assumption that the soloist will *lead* the performance while the orchestra must follow. In this way the live player teaches musicality to the system through imitation: if the soloist plays musically and the orchestra synchronizes with the soloist, then the orchestra absorbs and radiates appropriate musical expression. The orchestra's *follower* role is often presented nearly axiomatically by conductors in discussions about performance goals. Without doubt, there is a good deal of truth in the leader-follower division between soloist and ensemble — what success the Info Phil enjoys is predicated largely on this simple formulation. However, there are a great many situations where this leader-follower assumption breaks down when viewed under greater magnification. For instance, the orchestra must play with expression when the soloist is not involved, or when there is *conversation* between orchestra and soloist. In chamber music, the lead role, if it exists at all, is traded freely between players. With an early-stage musician the accompanist must offer support, accommodating mistakes and "do-overs," while guiding the musician toward a reasonable interpretation. To broaden our scope to include these additional scenarios we must model the role of our musical partner in a more sophisticated way. Rather than simply trying to follow, our system must have a clear internal agenda and know how to adjust this agenda in response to the actions of others.

We place modeling musicality at the very center of what is currently missing in creating musical partners. While musicality is often discussed as untouchable by scientific approaches, this missing connection is exactly the one that must be made. In essence, there are a great many variables involving timing, dynamics, and various continuous performance parameters such as timbre, attack, and vibrato, while musicality requires an understanding of their interconnectedness. A successful approach must treat notions of musical affect, prosody, and structural considerations, and would greatly expand the musical realm in which computers' musical contributions are satisfying.