

NEH White Paper

Dig That Lick

The “Dig that Lick” project, undertaken as part of the Trans-Atlantic Partnership *Digging into Data* scheme was remarkably successful in meeting its initial goals. Our proposal articulated an aim to “develop innovative technological and music-analytical methods to gain fresh insights into jazz history,” and by extension to offer new approaches for integrating work in music information retrieval and musicology. Ideally, we hoped this work would demonstrate value to both sides of that disciplinary divide. Our specific aims in relation to this larger goal were to bring together musicologists and computer scientists to “create a deeper and more comprehensive understanding of jazz in its social and cultural context...via a full cycle of analysis of melodic patterns, or ‘licks’, from audio recordings to an aesthetically contextualized and historically situated understanding.”

We can say now, at the end of this project that we have accomplished this analytical process and have found meaningful results that not only confirm ground truth in jazz history but also indicate new insights not immediately apparent from more standard music historiographical methods. The papers we have in press and under review offer an exciting prospect for future research using similar methodologies and data sets in jazz studies. Moreover, with new data sets relevant to other genres our methodologies could offer significant new approaches for the field of musicology at large. Likewise, the challenges related to music information retrieval from jazz as a genre have long been a stumbling block to better work in that field, which has otherwise tended to focus on classical and pop genres. Our

methodologies and datasets should allow for further work in music information retrieval relevant to jazz, thereby making that field more able to speak to larger topics if only by expanding the overall data on which its largest conclusions can be based.

Project Activities

Our project began with a dual process, compiling a dataset and preparing automated musical feature extraction tools. Both tasks had distinct challenges, and took longer than initially expected, but were absolutely necessary in order to the analytical challenge posed in the project at large. The challenges for dataset preparation are inherent in jazz as a recorded genre. The music is not generally defined by works, but by individual performances; but individual performances do not exist in unique iterations. Rather, individual performances, which correspond to specific recording sessions, are commonly distributed in multiple commercial products or releases. As such, selecting a representative set of songs from specific recording sessions was no small task. Likewise, discographical data are widely available, but have generally been collected by amateur enthusiasts, and are subject to no metadata standards (and are of uneven reliability). Attaching reliable, consistent discographical information to recordings is a significant challenge, but absolutely necessary in order to offer meaningful historical and social context to analyses of audio. Eventually we were able to compile a dataset, the DTL 1000, that represents a cross-section of jazz from throughout the music's century of history. It represents all subgenres of the music, and an international array of performers, weighted toward American artists as would be expected of a distinctly American art form.

The work of preparing these materials progressed in dialogue with further refinement of the music historical and musicological concept development necessary. A major essay on the state of research in melodic pattern as a defining feature of jazz improvisation was written and posted to the Dig that Lick website, and extensive work on a theory of musical similarity as well as its translation into signal processing terms was undertaken by the team at large. Here the biggest challenge involved adapting pre-existent feature extraction algorithms to describe melody and rhythm so that we run pattern search and pattern matching processes on improvised solo lines. For jazz this has long been difficult because of the complexity of the music and the fact that its rhythmic and harmonic elements generally operate on the basis of inference rather than explicit statement. The relationship between underlying structures of form and meter in both classical music and pop music are generally expressed clearly in the musical surface or foreground, and MIR tools built for analyses of those musical genres have generally not reliably identified structures in jazz.

The final prefatory hurdle that we needed to overcome was refining feature extraction to identify improvised solo lines in polyphonic mono and stereo recordings. This is a notoriously difficult challenge that required considerable tuning of preexisting tools. We were ultimately able to develop a toolkit that could accomplish necessary feature extraction work at the same time as we completed the audio dataset compilation.

Having done that, we developed a set of representations of monophonic solos from the DTL 1000 set and set about running pattern identification and pattern similarity algorithms using the jazzomat platform developed by our team members in Germany. This allowed us to

begin the more complex analytical tasks of identifying trends in the flow of musical patterns between artists.

Project Outcomes

The Dig that Lick team was able to present initial results from the project at conferences of the International Society for Music Information Retrieval and at the European jazz studies conference, Rhythm Changes, in years two and three of the project, before the pandemic hit. These initial results are extremely promising. The ISMIR papers were oriented primarily toward sharing the technical methodologies, with a focus on the genre-specific challenges, and the Rhythm Changes papers were oriented toward the humanistic results in jazz history. Individual scholars also presented results at jazz studies conferences in Canada, the U.S., and Germany, as well as at colloquia at the University of Iowa, Kings College, London, and the University of Illinois.

As a baseline for understanding the meaning of the results of the study we can report that certain ground truths found in the ethnographic, historical, and music cognition research on musical pattern as a basis for jazz improvisation were fully supported by our methodology. We found, as have scholars across the interdisciplinary field of jazz studies, that the recorded archive of jazz is overwhelmingly suffused with non-trivial musical pattern, and that such patterns—“licks” in our parlance—are shared between musicians and can be viewed as a means to understanding relationships between artists who share cultural networks. Moreover, we found that certain musicians who are thought of as pattern-users tended were confirmed by the search algorithm as having recordings that were suffused by pattern. Likewise, musicians

who are widely thought of as influential tended to have high levels of connection to a wide array of other musicians in pattern similarity algorithm results. These are not particularly ground-breaking finding, but nor are they meant to be; rather, together they provide evidence that the algorithms offer a level of reliability as jazz historical tools.

Beyond the confirmation of ground truth, our research pointed to less intuitive conclusions. A study of the canonical saxophonist and composer, John Coltrane, found that patterns from a piece that has not generally been seen as historically important (“Blue Train”) may actually have had a bigger impact than patterns from pieces that have become canonical in jazz history writing, notably “Giant Steps.” This is interesting, beyond the very specific case, because it points to the wide diffusion of melodic patterns somewhat separate from other aspects of jazz music. “Giant Steps” is important as a historical recording in its unique harmonic structure, and its *gestalt* as part of a moment of intense innovation, and “Blue Train” is not. Nevertheless, certain elements of Coltrane’s solo on “Blue Train” appear to have stuck in the ears of his contemporaries and somewhat junior artists, and found their way into a remarkable number of performances thereafter. Notably, while almost every jazz artist has adopted the harmonic features of “Giant Steps” as a form, the artists who have taken on the licks associated with “Blue Train” are a cluster of mostly saxophonists who can reasonably be described as “post-Coltrane” players. A number of similarly small case studies that nonetheless point toward larger conclusions have come from this research and are in press or under review now.

Interestingly a meta-analysis of pattern relationships suggests another large conclusion, which has to do with differences between broad influence and intensive influence. Certain musicians—Louis Armstrong, the cornetist and trumpet player who is among the music’s first

great soloists—have had very wide influence, their patterns showing up in the playing of nearly all musicians in the dataset. Others have influenced a few artists, but done so in deep ways. We suggest this can be described in terms of a difference between artists who have established “languages” in jazz—or put otherwise, who have initiated paradigm shifts—and artists who have cultivated distinct, relationship-based musical networks of influence. Further research will be needed to fully describe this in the data, but the historiographic implications are significant.

Project Impact and Continuation

This project has clearly had a meaningful impact, but needs continuation to see its potentials through. The field of musicology at large is only starting to take on data analytic research as a value, and the field of music information retrieval is only now starting to develop the tools that allow for the kinds of sophisticated research needed to make data analytic studies of recorded music feasible. Our tools and our methodology offer a model for a path forward in both regards. As evidence that there is interest in this, the *Journal of the American Musicological Society*, the flagship journal for the discipline of musicology in the U.S., has reached out about a featured review of the project.

Nevertheless, not only are there significant unanswered questions, more importantly few music scholars have the capacity to work with the tools or data we have produced yet. This team is uniquely well-suited to continuing the work and are actively seeking funding to support that continuation. The pandemic and large-scale financial instability it has ushered in have made such support harder to find, but we are hopeful to continue our collective study in coming years.

