

The perception and importance of drum tuning in live performance and music production

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Abstract

Intricate setup and tuning of acoustic drums can have a significant and valuable impact on the quality and contextuality of the instrument when played alone or as part of a music group performing live or in the recording studio. Indeed, many record producers will spend a number of hours achieving the preferred drum sound at the start of a studio project. Similarly, live performances may require an exact drum sound every night, so knowledge and repeatability of drum setups can be a valuable asset. Drum tuning, however, is a rather subjective matter. There is no correct benchmark for 'in-tune' like there is for most other musical instruments, it is very difficult to define why a particular drum setup might sound good when another does not.

A research study has been conducted to assess how performers and producers interpret and value the importance of drum tuning in their specific field or music genre. Research has been conducted by a combination of one-to-one interview, focus group discussion, questionnaire, and through the authors' own experiences of drum performance and recording. This paper presents and discusses the results of the study.

Conclusions of the research show that advanced musicians do have the ability to tune drums by ear, and do greatly value the differences that can be made. Less advanced musicians are aware of the benefits that can be made by knowledgeable drum tuning, but many do not possess the skills to achieve the desired results. Unfortunately, owing to the subjective nature of drum tuning, there is currently no qualified method for educating novice practitioners. Of the music producers interviewed, the importance of drum tuning was high on their agenda, and there is evidence that any technical methods for standardising or benchmarking particular drum setups would be embraced. This paper therefore discusses drum tuning, with particular reference to analysed waveform data, in an attempt to demystify the methods used and provide a first step towards advancing knowledge and further educating performers and producers alike.

1 Introduction

Intricate setup and tuning of popular acoustic drums can have a significant and valuable impact on the quality and contextuality of the instrument when played alone or as part of a music ensemble performing live or in the recording studio. Some record producers will spend a number of hours achieving the preferred drum sound at the start of a studio project. Similarly, live performances may require an exact drum sound every night, so knowledge and repeatability of drum setups can be a valuable asset.

Drum tuning, however, is a rather subjective matter and, in comparison to other instruments, drums are regarded as being “much more difficult and challenging” to tune (Schroedl, 2002). This is predominantly owing to the number of degrees of freedom in the tuning setup. A drum within a standard drum kit setup usually consists of two taught drum heads held on to a drum by a number of tension rods, each of which can individually alter the tuning setup.

At present, there is no standardised benchmark for ‘in-tune’ like there is for most other musical instruments. It is also very difficult to define why a particular drum setup might sound good when another does not. It is generally accepted that there are a number of techniques and setups that allow the drums to be classed as ‘in-tune’. This study, however, does not intend to state which methods or setups are right or wrong, moreover the definition of ‘in-tune’ is regarded as being ‘with the desired sound’. So, the topic of tuning is classed as an issue of being in control of and influencing the resultant sound of the instrument, as also described by Ranscombe (2008).

A research study has been conducted to assess how performers and producers interpret and value the importance of drum tuning in their specific field or music genre. Research has been conducted by a combination of one-to-one interview, focus group discussion, questionnaire, and through the authors’ own experiences of drum performance and recording. This paper presents and discusses the results of these discussions in Sections 2 and 3.

Furthermore, digital signal analysis has been used to quantify a number of acoustic and vibration factors affecting drum setup and tuning. Section 4 uses waveform examples to discuss acoustic properties of the drum and investigates how this knowledge might be used to assist drum tuning and benchmarking preferred sounds. This paper, therefore, attempts to provide a first step towards advancing the technical knowledge of drum tuning setups and further educating performers and producers alike.

2 Drum tuning in music production

2.1 Practical issues with drum tuning

In many recording sessions, the drum setup has a very important role. The setup involves choosing the correct drum kit, choosing and positioning microphones for recording the drum kit, and tuning the drum kit to give the desired sound.

The drum setup process is often the first step in a recording session, as many music producers prefer to achieve a suitable rhythm track before overdubbing lead instruments. From our interviews with record producers, it was expressed that for recording projects lasting 2-3 weeks, the drum setup can account for 15-25% of the entire project, particularly if alterations are required between songs. Record companies are no longer willing to spend large funds on recording projects, so a ‘right first time’ approach makes economic sense, as discussed by mix engineer Chuck Ainlay (Massey, 2003, p280). If the drum setup is correct, the recording session can move swiftly and the mix down process can be simplified. It appears that producers are not willing to cut corners on the drum setup, but assistance to speed up and guarantee the correct setup would be embraced.

Drum tuning can also be a creative tool in the studio, especially to underpin the music genre being recorded. Rock, Metal, Pop and Jazz genres all use subtly different drum setups, and a knowledgeable drum technician can make a big difference in the way the drums sound in context with the rest of the music being recorded.

Other issues encountered in the studio with respect to drum tuning involve dealing with poor quality drum kits, changing drum heads half way through a session, and chasing a desired drum sound that was achieved once before. A producer or artist might want to emulate the drum sound on a previous recording, but, given that there is currently no quantitative method for benchmarking drum sounds, this is very difficult to achieve qualitatively and by ear alone.

2.2 Tuning and maintaining the desired sound

Drum tuning in the studio particularly focuses on the pitch of the drums and the decay time of each drum sound.

Drums for Jazz music are generally tuned higher and with a longer decay than drums for Rock music, so pitch ranges can be suggested for different music genres - as for example by Mike James (2008). Tuning for a particular genre is practiced by the musicians and producers interviewed, but some interviewees also expressed a desire to tune the drum kit to the specific key of the song being played. Producer John Leckie states that

“The two things that identify a record are the vocal and the snare drum”,

(Massey, 2003, p104)

and it has been expressed that it is possible for the pitch of the snare or toms to be at odds with that of the bass guitar or other instruments. So, the specific tuning of the drum kit does have the ability to ‘make or break’ the recording. It has been expressed by the interviewees and by Toulson (2008) that fixing the drum pitch afterwards in post processing is not always a viable option. It is only possible to enhance frequencies that are evident in the original audio signal (Oswinski, 1999, p), so if the drums are tuned to the wrong pitch, then usually the only post processing option is to replace the drum sounds with triggered samples – again adding time and complexity to the mix down process.

The decay profiles of the drums in a drum kit are also tuned to give the desired sound in context with a song. For example, a slow tempo song might utilise drums with a long decay time to ‘fill the space’ between the musical notes. However, longer decay times might drown out the music in an upbeat song. It has also been expressed that as well as the overall decay time being a tuneable value, the decay times of the individual frequency components of the sound should all be similar too. For example, a drum sound might have a low frequency fundamental pitch and a high frequency overtone related to the drum shell and its construction. It is not desired for the low tone to decay quickly and the high tone to decay slowly, as this can result in a high frequency ‘ringing’. A suggested approach is to achieve a decay time that is similar for all components of the drum sound’s frequency spectrum. There are many products available for altering the decay times of acoustic drums; however it is very difficult to quantify the effect of these products by any means other than by ear. It is therefore difficult to quantitatively benchmark drum pitch and decay times for future reference.

3 The performer’s perspective

3.1 Advanced and professional musicians

Discussions with professional percussionists indicate that drum tuning is an essential part of their craft. Expert percussionists appear to have a considerably personalised approach to drum tuning, though all ultimately tune by ear to the point where the drum sounds as desired.

Repeatability of sound can be an issue for even expert drummers however. The professionals interviewed expressed that they can always tune a drum kit to a desired sound by ear alone, but they might not be able to achieve exactly the same sound every time, which may or may not be a problem.

The need for professional percussionists to have extra control over their tuning setup is predominantly when in the recording studio or performing on a high profile tour. In the studio it is not uncommon for a difference of opinion between the drummer and the producer on the tuning of the drum. It is noted that a common scenario is where the producer wants a heavily damped (quick decay) sound, but the drummer would prefer a less damped setup. Quantitative benchmarking of sounds would allow more reasoned debate on which particular setups have been successful in the past and which haven’t.

Repeatability of sound can be an issue on high profile tours where, for example, the drum sound is required to be as close to that of the artist’s recorded work as possible. In this case the drum sound is desired to be consistent on every night of the tour, and some method for achieving this is attempted by the sound technicians. Repeatability and benchmarking also become issues when considering that many percussionists desire to tune their drums to a particular musical scale or the key of a particular song, for example Geoff Dougmore (Keefe, 2008). Currently the only method for this is by ear, using a reference tone or a piano to tune towards.

It appears that expert percussionists are indeed in control of their sound, and their ears are generally accurate enough to allow drum tuning unassisted. Drum tuning is a personal issue that can separate one musician from another, so in many respects a quantitative or standardised method for drum tuning

is not essential for these performers. However, it is also felt that a method for recording and benchmarking tuning setups could be embraced.

3.2 Discussions with novice musicians

A focus group session with new drummers (1-3 years playing experience) indicated that tuning by ear is very challenging, and as a result most did not attempt tuning to any particular accuracy, saying they would prefer to concentrate on their playing technique. Drum tuning is difficult by ear, and the introduction of quantitative data could complicate the process further for this cohort. Those interviewed, however, were conscious of the advantages that precise tuning provides and expressed a desire to improve their ability in the future.

Benchmarking of sounds and setups was an interesting concept to the focus group. The opportunity for a new drummer to tune their kit to a 'Rock' setting or a 'Jazz' setting would be embraced. Indeed, some drummers explained that they only owned one drum kit which might be used for a Rock performance one night, and a Jazz performance the next night. Any assistance in quickly tuning their kit from one genre setup to another would be of benefit. Furthermore, the ability to replicate the drum sound of a favorite musical idol was an area where quantitative benchmarking could provide a unique advantage.

The discussions with novice musicians highlighted that drum tuning is indeed a universally appreciated skill, but one that is expected to be learnt automatically as a result of many years playing and listening. There appears to be no guarantee that this skill will embed with all percussionists, however, and there is no current method to accelerate the process of learning.

3.3 The talented hobbyist and part-time musician

During our investigation a third cohort appeared; those who fell between the classification of 'novice' and 'expert'. Many percussionists are hobbyists who have perhaps played for many years and are quite talented and/or experienced. These musicians may perform and record regularly, but do not make their profession out of music.

Part-time musicians now make up a large number in the global recording industry, self-funding projects and expecting good recordings in a short timeframe. Indeed, many commercially successful musicians are now forced to find extra routes of employment, given the current tightening of recording budgets and record deals in the music industry. Of the percussionists who fall into this group, most would argue to being proficient musicians, but at the same time most were willing to admit a level of inability in drum tuning. These performers are often musicians who have a good ear for tone and quality, but do not have such accurate hearing to perform precise tuning. One such percussionist explained that they apply a 'twist and hope' attitude with drum tuning.

In addition, the part-time musicians are often experienced in studio projects and understand the basics of acoustics and recording principles. For this reason it appears that the cohort would be willing to embrace some form of technical assistance in drum tuning.

4 Defining a quantitative approach to drum tuning

4.1 The acoustic behaviour of a drum

The sound of a drum varies dependant on where the drumhead is hit. This is because different vibration modes are excited by impacts at different locations on the drum, as defined by the mechanical theory for experimental modal analysis (Ingard, 1988, p131).

Figure 1 shows the waveform and frequency spectrum of the drum acoustic when the vibration is excited and measured at the centre of the drum head. The drum used here measures 12" diameter and 9" depth; more particular details of the drums used in this research are included in the Appendix. The tuning lugs around the perimeter of the drum can be used to raise or lower the pitch of the drum. In Figure 1 it can be seen that the drum head has been tuned to have a fundamental pitch of 147 Hz, which corresponds to note D_3 on the musical scale. We will refer to this fundamental frequency as F_0 .

If the same drum with the same tuning setup is excited and analysed at the perimeter of the drum, the fundamental mode is not particularly evident, as shown in Figure 2. Here we see a second frequency component (or 'vibration mode') at 220 Hz. We will refer to this second frequency component as F_1 .

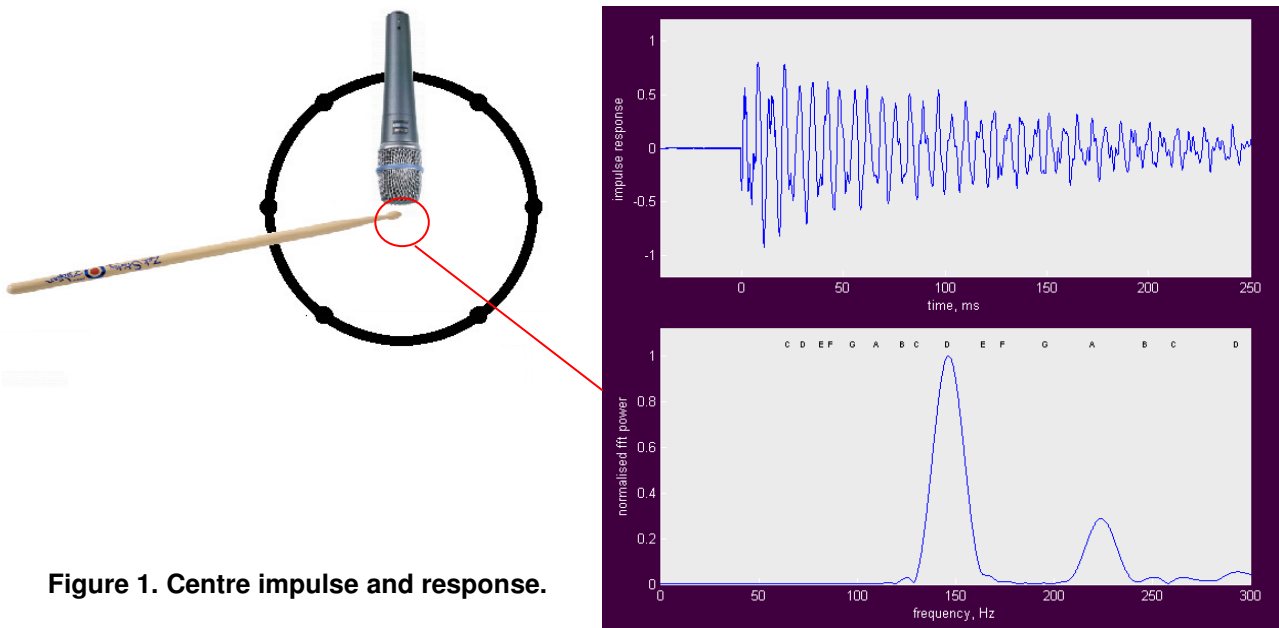


Figure 1. Centre impulse and response.

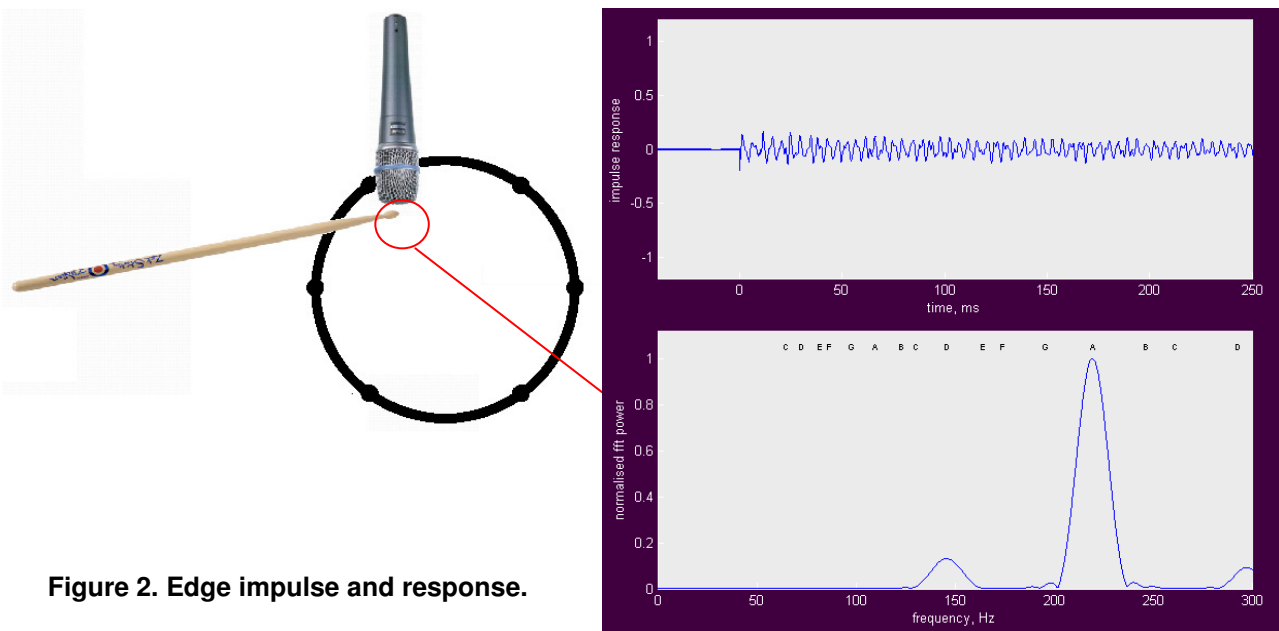
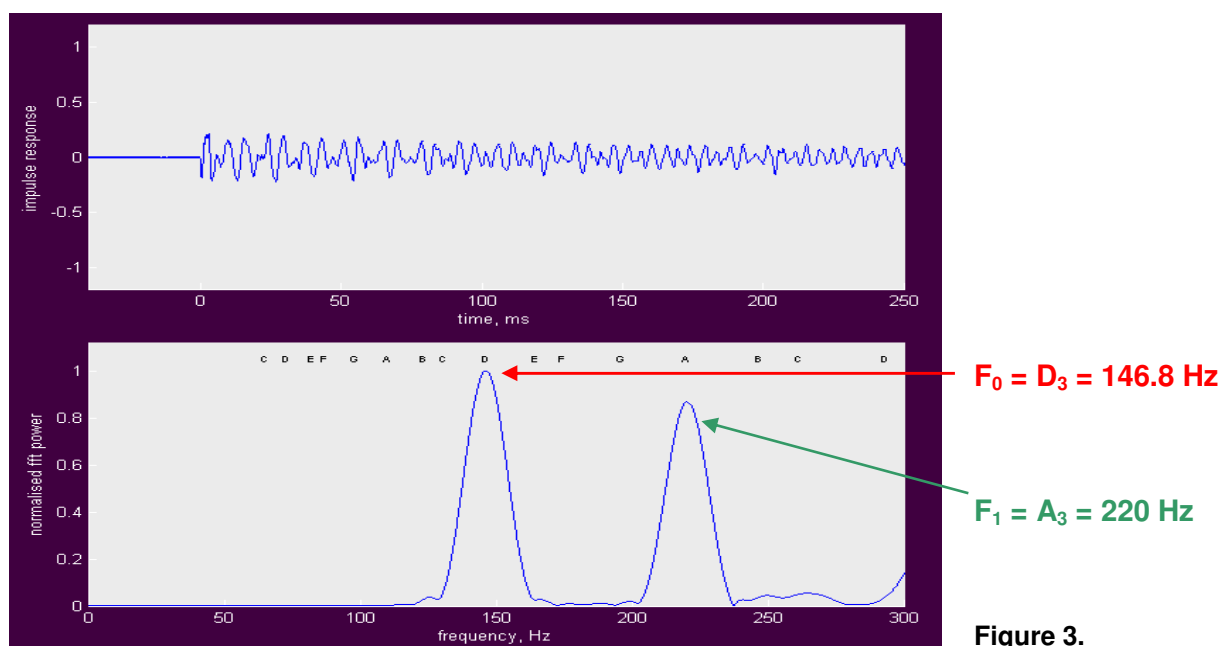


Figure 2. Edge impulse and response.

It is no coincidence that in this example the frequency F_1 (220 Hz) relates to the musical note A_3 . The present research has shown that the fundamental mode, F_0 , relates to the motion of the mass of air inside the drum. This frequency is therefore predominantly dependent on the size of the drum and the tension of the two drum heads (the batter and resonant or 'top and 'bottom' heads). Here, adjustment of either the batter or resonant drum heads will alter the fundamental frequency.

The frequency F_1 , however, is seen to be more localised to be dependant on the dimensions and tension of the batter head alone, so adjustment of the resonant head has little influence. It is therefore possible to adjust the relative tension of the two drum heads and hence independently alter the frequencies F_0 and F_1 . So the drum analysed in Figures 1 and 2 has been tuned to give this exact response.

Furthermore, it can be seen that excitation and analysis at a location between the centre and the edge will excite both F_0 and F_1 a similar amount, as shown in Figure 3. So it is indeed possible to tune a drum to have two chosen desired musical modes, and to excite these in unison, resulting in a rich musical tone.



The mechanical properties of drums and percussion instruments are discussed in detail by Rossing (2000). However, Rossing admits that “relatively little has been written about scientific research on these instruments” to date. Rossing discusses the vibration characteristics and modes of different drums in the popular drum kit; but, even here, little acknowledgement is made to the setup and tuning of the drums under investigation.

4.2 Tuning the pitch of the drums in a drum set

The ability to tune drums to a specified fundamental (F_0) pitch means that performers and record producers can tune an entire drum kit to a musical scale or reference. This type of tuning is performed by ear by a number of professionals who tune drums to specific notes by using a piano as a reference, for example Geoff Dougmore (Keefe, 2008).

The drum kit described in the Appendix has been tuned to give the fundamental tones shown in Figure 4. A descending drum roll on the kit described in Figure 4 will therefore give a musical scale through the following fundamental notes

$$14'' \text{ snare} \rightarrow 12'' \text{ tom} \rightarrow 13'' \text{ tom} \rightarrow 16'' \text{ floor tom} \rightarrow 20'' \text{ kick drum}$$

$$=$$

$$G_3 \rightarrow D_3 \rightarrow B_2 \rightarrow G_2 \rightarrow E_2$$

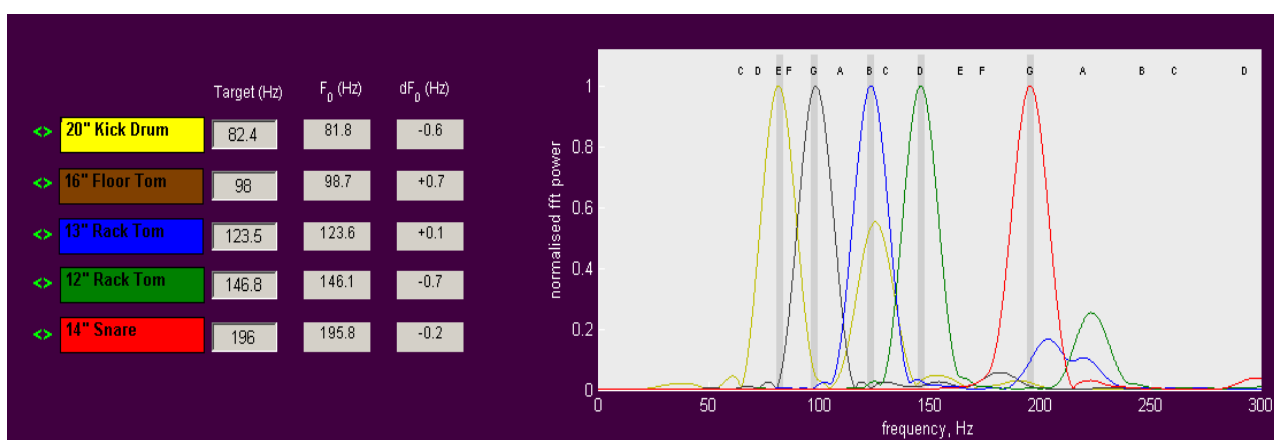


Figure 4.

The musical pitches chosen have been deduced from the outputs of testing and interviews with experienced drummers and recording engineers. This setup is intended to be a ‘multi-genre’ setup,

however it has been observed that, in general, drums sounds associated with Rock drumming tend to be tuned to a lower pitch, whereas those associated with Jazz drumming tend to be higher pitch. The associations between drum pitch and music genre is an area of current and continuing research by the author.

4.3 Attack and decay profiles

As discussed previously, the decay profiles of drum sounds are often debated between musician and producer. Many drummers prefer an open sound with a decay that sustains the tone of the drum. Conversely many producers prefer a damped sound which will not overcrowd the recording. It is felt here that precise tuning of a drum's pitch allows the decay of the response to be in key with the music, so longer decay times can possibly enhance a recording. A second point to note for recording drums is that often producers desire the decay time to be matched to the tempo of the song, so it may be possible to suggest a delay time given the song's BPM (beats per minute).

It is possible to measure the decay time of drum sounds, and suggested standards are to consider the decay time, T_d , for 20 db, 30 db or 40 db reduction. A number of products, such as RTom Moongel (see www.rtom.com) and Evans E-Rings (see www.evansdrumheads.com), do exist for altering the decay profiles of drums. For example, Figure 5 shows that it has been possible to reduce the overall (20 db) decay of a 12" tom from 752 ms to 199 ms by the use of damper rings. Damper rings in general affect the frequency modes at the perimeter of the drum, so here the reduction in decay time is predominantly by a reduction of the decay time of the F_1 mode and overtones.

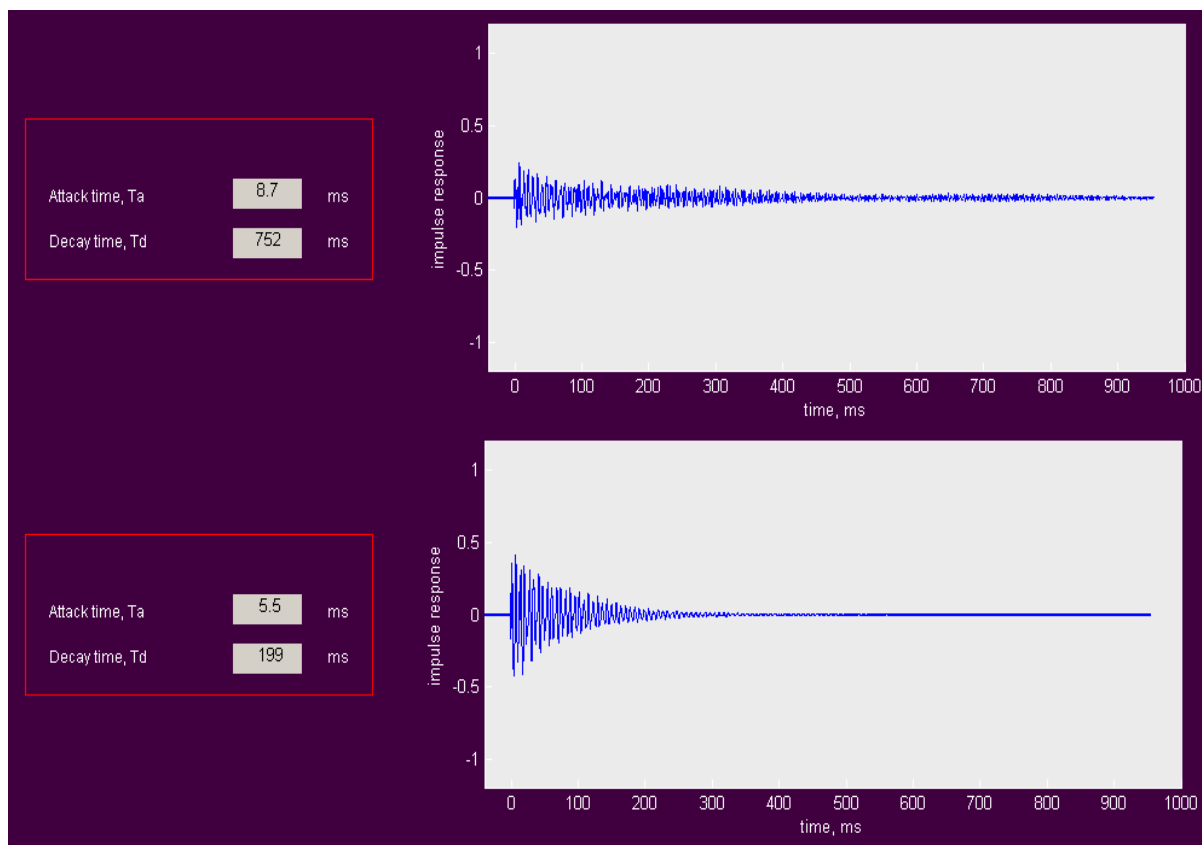


Figure 5.

The attack profile of an impact can also be measured. Here we are interested in the time taken for the signal to rise from its initial onset to its maximum value. In Figure 5 it can be seen that the attack time has reduced from 8.7 ms to 5.5 ms by the addition of the damper ring. Many texts suggest adding some high frequency boost in post processing to enhance the attack of the drum signal, for example Robinson (2006). However, it is suggested that achieving a desired attack profile is an essential task in drum tuning, and it is possible to change the attack time by changing the materials of the drumhead or the drum stick or beater. So, with more precise tuning, the recording can be much closer to the final desired sound, and hence simplifying the mixdown task.

4.4 Other tuning factors

It must be noted that many other factors affect the tuning of a drum kit, including

- drum sizes and dimensions
- the material of the drum shells and tuning mechanisms
- drum head types
- cymbal selection
- drumstick choice

Each drum has its own range of tone that it can be suitably tuned to. For example, a 12" tom can be tuned to have a fundamental within a specific frequency range. But as it is tuned lower and lower, eventually the drum head will go slack and the tone will become poor. At this stage if a lower tone is required, a larger drum should be used. Drums are also made with different depths and of many different materials by many different methods. Similarly, the types of drum heads used have a major impact on the available tuning ranges and attack and decay profiles. Furthermore, the choice of whether to use the same or different heads on the batter and resonant sides of the drum have a major influence. These factors are all under consideration in the current research.

At present, however, this research is predominantly concerned with understanding a particular drum setup and the tuning options available within that setup (the particular setup used here for data analysis is described in the Appendix). Once this knowledge capture is complete it is possible to look at multiple drum setups and consider extra factors, particularly with correlating drum sizes, materials and drum heads to specific tuning options and music genres.

5 Conclusions

It has been seen that drum tuning plays an important role in music production and performance. This is most obvious in recording projects where the drum sound has a major influence on the quality and context of the produced music. In addition, expert percussionists have a passion for drum tuning and see this as a very personal subject, one which often causes debate during the recording process. In these instances a more technical approach to tuning could be embraced to achieve a quantified and more precise sound profile and to capture benchmarks for future reference.

Beginner and part-time musicians admit to being challenged by drum tuning, and benchmarking towards standard 'Rock', 'Pop' and 'Jazz' setups would appear to be of value. A major challenge here however is simplifying any technical procedure to not confuse musicians further.

A quantifiable method for drum tuning has been developed and is being evaluated in the author's current research. Of course, some musicians and producers will not embrace yet another technical method within their artistic field. But, it is felt that, at the technical level where waveform and spectrum analysis are the norm, this approach could be embraced to give the valuable capture, analysis and benchmarking of drum sounds and tuning setups.

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8 Appendix

The hardware used for analysis in the figures and examples within are as follows:

Drum shells:

- All Tama Superstar Series drum shells (7ply birch/basswood)
- 20 x 18 inch (diameter x depth) bass drum
- 12 x 9 inch tom drum
- 13 x 10 inch tom drum
- 16 x 16 inch tom drum
- 14 x 5.5 inch snare drum

Drum heads:

- Evans EC2 coated batter heads
- Tama standard resonant heads

Microphone:

- Beyerdynamic Opus 67 Dynamic