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Fine Tuning Percussion – A New Educational Approach

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Abstract

A number of skills and techniques involved in music technology are rarely taught in a formal manner. Originally, ear training and listening skills were assumed to be acquired automatically as practitioners gain knowledge and experience in their field. However, in recent years, well developed education methods for assisting and accelerating ear training have proven successful.

A related skill, which has no current formal education method, is the practice of drum tuning. The tuning of acoustic drums can have a significant effect on the success of a recording project, however, this is a largely subjective matter and drum tuning is often considered something of a 'dark art' amongst emerging drummers. One popular method involved in drum tuning is to 'clear' or 'equalise' the drum head, to ensure an even response by tapping the drum head around the perimeter of the drum and checking that a consistent sound is achieved at all locations. This technique is discussed in a number of popular texts and magazine articles, but to date has not been evaluated in a scientific context. Thus, no formal or quantifiable method of educating a technician in clearing the drum head has previously existed.

This paper uses modal analysis techniques to investigate the effect of clearing a drum head. It is shown that it is indeed possible to quantify how uniform the drum head tuning is via simple acoustic analysis; i.e. with a drumstick and a microphone. The effect of clearing a drum head with respect to the tension of the head, as opposed to the audible response, is shown to be ineffective in a number of cases, indicating that the drum head should indeed be tuned by analysis of the audible response rather than to the exact tension of the drum head itself. Furthermore, a drum head with a non-uniform response can be seen to exhibit beat-frequencies, producing an uneven profile to the drum response decay envelope.

It is apparent that while many expert musicians have the ability to tune drums by ear, an intelligent tuning aid provides significant benefits to those who are still learning their trade, be it as a musician or a record producer. The visual feedback produced by the novel and bespoke analysis software used in this paper can help musicians and producers make more informed choices with regards to their drum sound. Furthermore, the developed methods for drum tuning allow the development of a standardised education method for assisting and accelerating the learning of this skill.

Summary

The tuning of acoustic drums can have a significant effect on the success of a recording project.

One popular method involved in drum tuning is to 'clear' the drum head, to ensure an even response by tapping the drum head around the perimeter of the drum and checking that a consistent sound is achieved at all locations.

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The following issues will be covered:

- The importance of drum tuning in music performance and production.
- The acoustic response characteristics of drums.
- Clearing the drumhead.

Drums and percussion in music production

- The importance of a drum sound for the specific music genre
- Drum setup can take 15-25% of the session?
- ‘Right first time’ recording
- Revisiting/replicating drum sounds
- Personal benchmarks
- An indication that studio engineers and producers would embrace technical assistance in drum tuning

The Novice musician’s perspective

- Drum tuning is a considerable challenge
- No quantified education methods
- Would embrace the ability to tune their kit to a particular genre or to replicate the sound of a favourite musician
- Often uncomfortable with advanced technology and engineering terminology

(Toulson, E. R., et al 2008)

Some quotes on drum tuning and drum production

- In comparison to other instruments, drums are described as being “much more difficult and challenging” to tune (Schroedl, 2002)
- A uniform or even pitch around the perimeter drum is desired for a “nice tone that decays with a smooth even note” (Ranscombe, 2006b)
- “The two things that identify a record are the vocal and the snare drum” (John Leckie in Massey, 2003)
- “It’s a small thing like tuning your snare drum to the track, if someone is singing in A and your snare is B flat your jiving all over the place it just doesn't sound right.” (Geoff Dougmore interviewed by Dolbear, 2009)
- ‘If your drums are well tuned and with the correct head choices, there really should be no need for additional dampening ... no o-rings and absolutely no pillows, towels or other such stuff. ’ (Ranscombe, 2006b)

Quantitative drum tuning methods

- Setting the fundamental drum pitch and overtones. Tuning the drum heads relevant to each other
- **Achieving a uniform frequency response around the drumhead**
- Tuning the pitch of the drums in a drum set
- Controlling attack and decay profiles

Four types of learning

- Kinesthetic – Learning by doing
  - Learning how to tune drums through practice tuning drums
- Read/Write – Learning from books
  - Learning through reading articles/books/guides on drum tuning
- Auditory – Learning by listening
  - Learning how to tune by listening to how alterations in tuning affect the drum sound
  - Audio CDs in drum tuning books
- Visual – Learning by seeing
  - How can we see whether a drum is in tune?

Understanding the acoustic response characteristics of popular drums

- Percussion acoustics researched by Thomas Rossing (2000), who states:

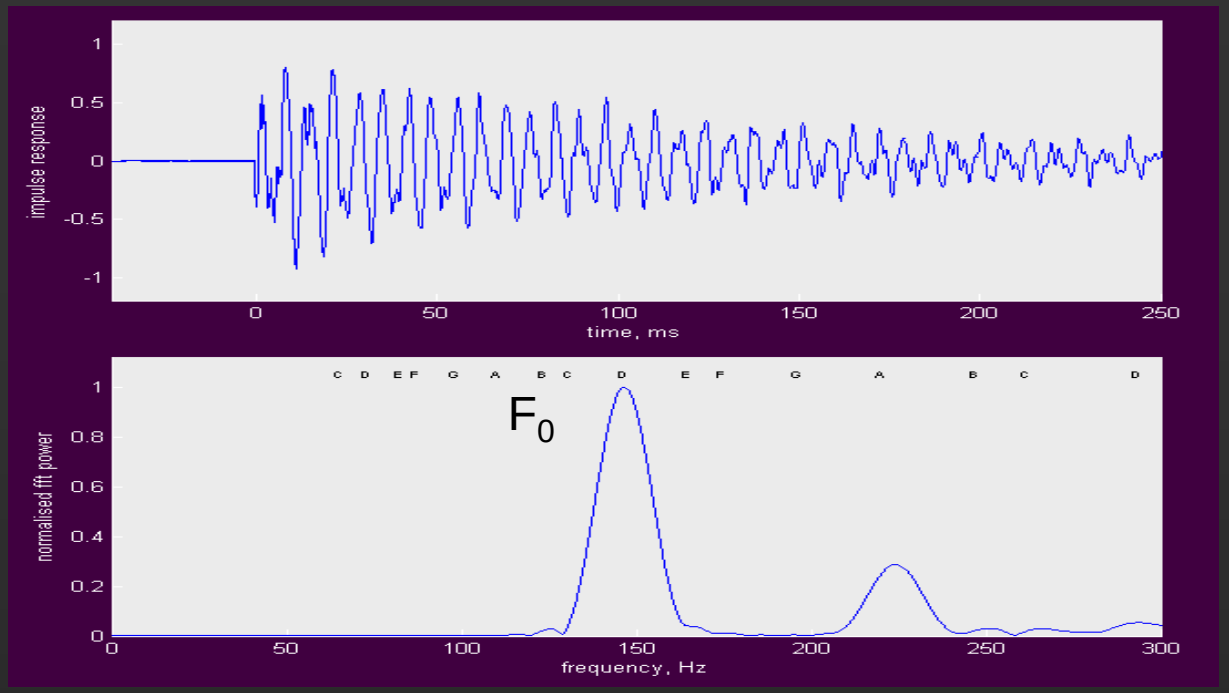
"relatively little has been written about scientific research on these instruments"

- A complex multi-degree-of-freedom instrument
  - Multiple vibrating masses; drum heads, drum shell, air
  - 10-20 tuning lugs per drum
  - Complex boundary conditions (taut drum heads)

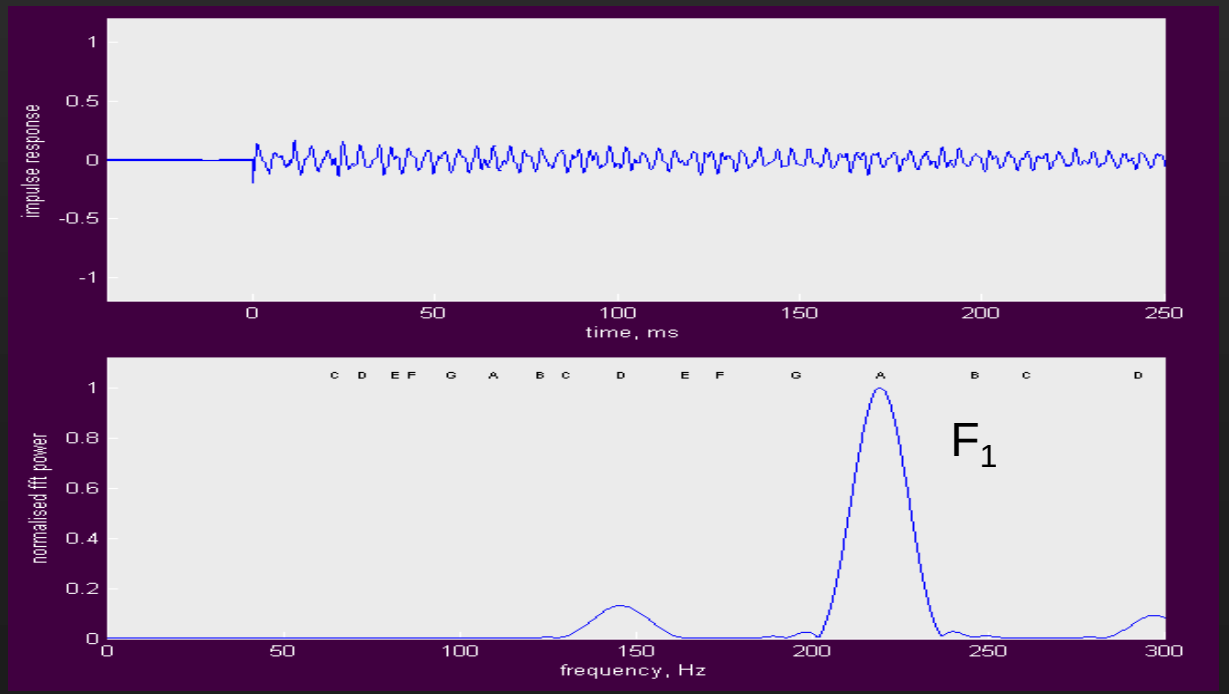
- Very difficult to model accurately mathematically

- Simple observations of drum acoustics can be useful when considering drum tuning

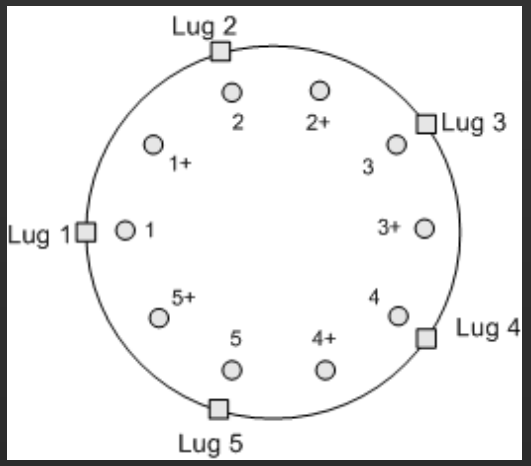
Centre impact and response

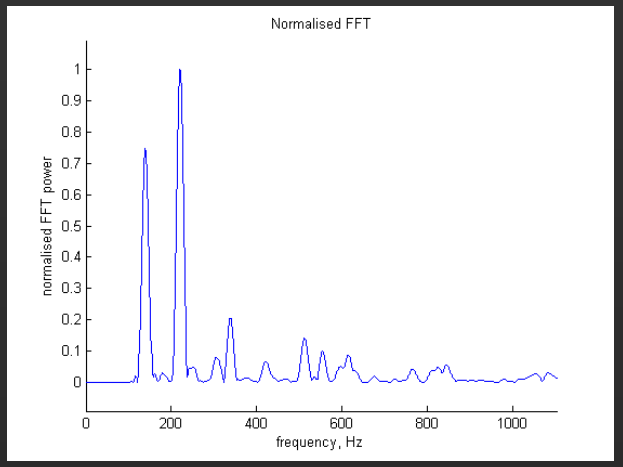


Edge impact and response

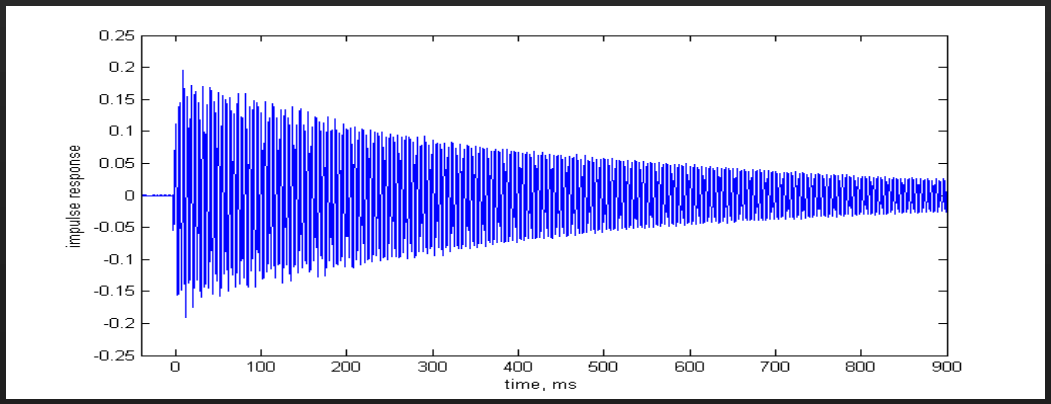


Achieving a uniform pitch around the drumhead



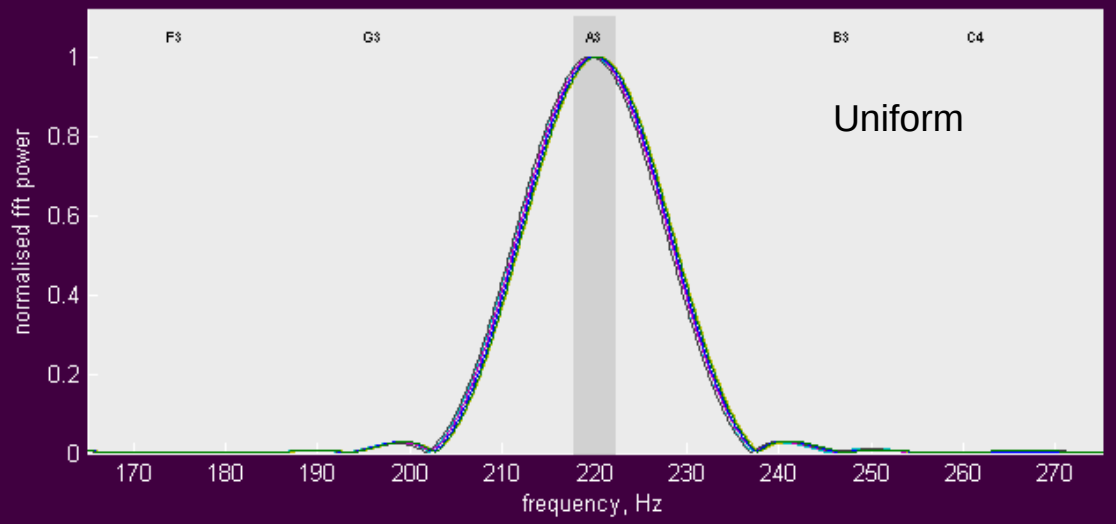


- Analysed locations for a 5-lug tom.
- Normalised FFT for 30-cm tom drum with uniform frequency response
- Example waveform produced when uniform frequency for f_1 is achieved

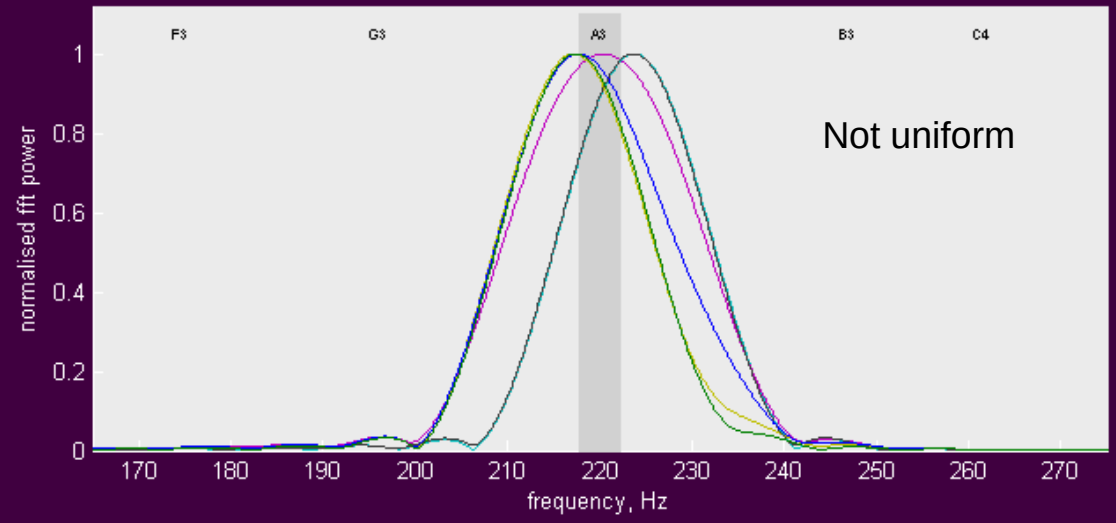


Achieving a uniform pitch around the drumhead

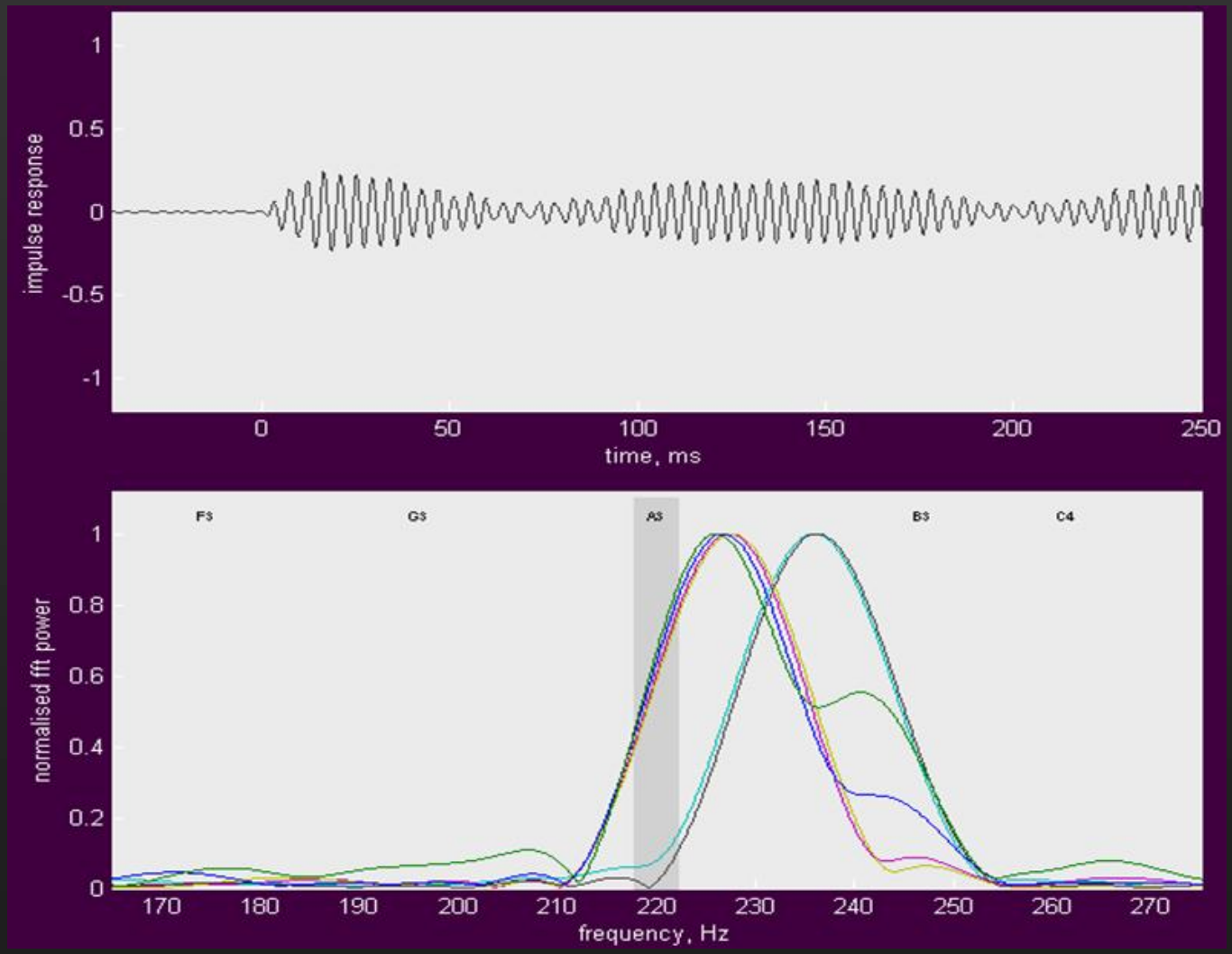
		F_1(Hz)	dF_1(Hz)
<>	Lug 1	219.6	-0.4
<>	Lug 2	219.9	-0.1
<>	Lug 3	220.4	+0.4
<>	Lug 4	219.6	-0.4
<>	Lug 5	220.1	+0.1
<>	Lug 6	220.3	+0.3



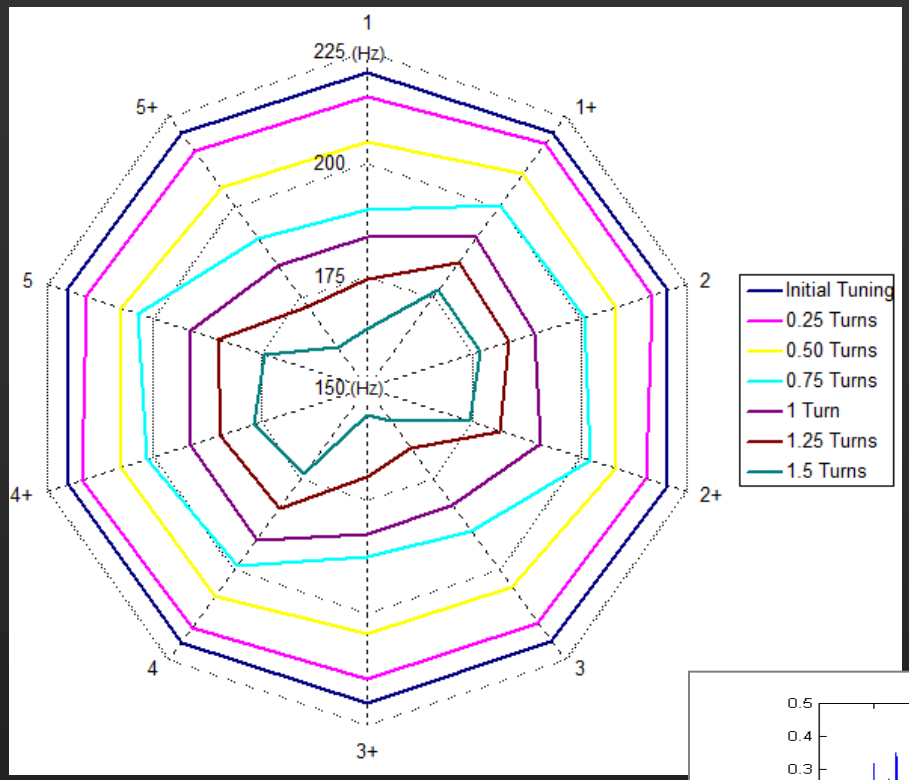
		F_1(Hz)	dF_1(Hz)
V	Lug 1	223.7	+3.7
<>	Lug 2	220.5	+0.5
^	Lug 3	217.2	-2.8
V	Lug 4	223.7	+3.7
<>	Lug 5	217.8	-2.2
^	Lug 6	217.4	-2.6



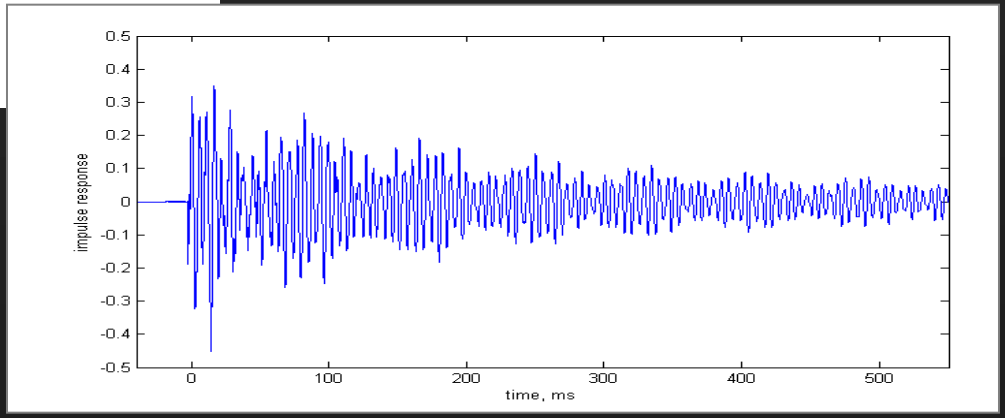
‘Beating’ in non-uniform tunings



‘Detuning’ the drum



- Drum detuned in quarter turn increments at tuning lug 3
- Locations at opposite sides of the drum are similarly affected
- Example waveform produced when frequency f_1 is non-uniform



Future research and development

- Educational methods can be improved for other drum tuning/timbre factors
  - Relationship between batter and resonant drumheads
  - Attack and decay profiles
  - Drum head types
  - Drum shell material and construction
  - Drum dimensions
  - Orchestral drums
- Further investigation of quantitative drum tuning for specific music genres and performance environments
- Continued investigation of the value of the gained knowledge to the musician and record production community

Summary / Recap

1. Uniform frequency response can be obtained through use of frequency analysis software
2. A uniform frequency response around the perimeter of the drum results in an even, consistent decay of the drum waveform
3. Frequency splitting and the beats in the waveform indicate that a drumhead is no longer in tune with itself
4. Visual feedback can be used to aid novices in learning how to tune their drums
5. Scope for future research
6. Question and answer

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