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Objective Measurement of Sound Quality in Music Production

Objective Measurement of Sound Quality in Music Production

- Steven Fenton Supervised by Dr B.Fazenda & Dr J.Wakefield

Inspiring tomorrow's professionals

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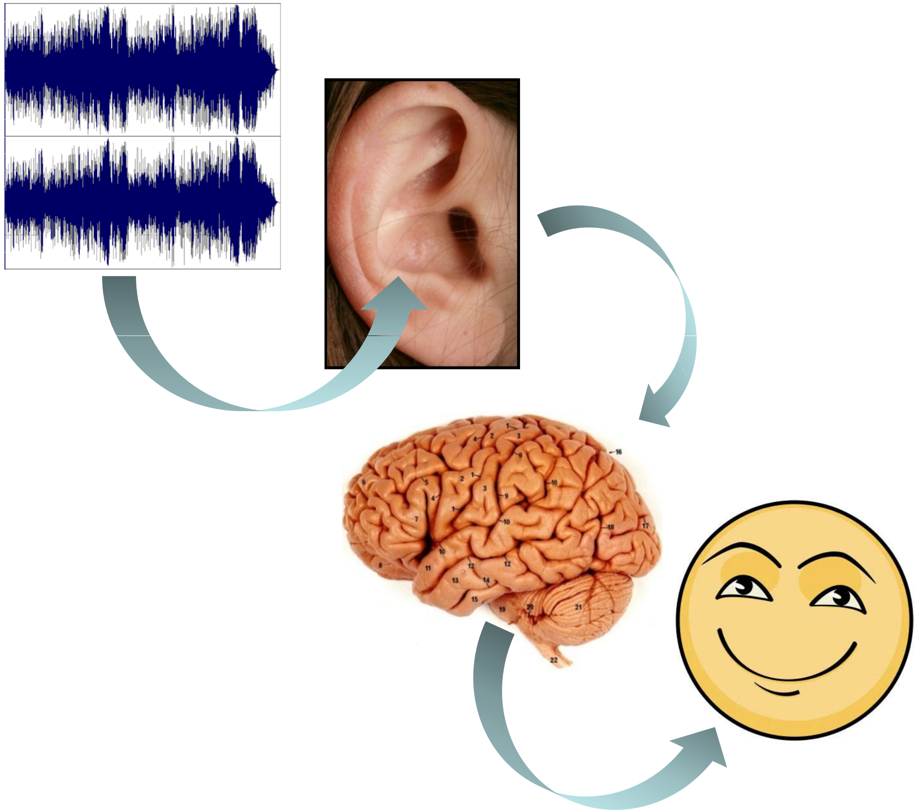
Subjective Testing Problems



Problem

- Testing (and our perception) of music quality is often subjective.
- We listen to the music and our brains interpret the overall quality of the piece.
- Subjective testing attempts to categorise the piece of music with descriptors such as Woolly, Bright, Boomy, Dark, Warm, Wide and Narrow amongst others to specify it's quality.
- Subjective testing by nature is not consistent and can be affected by taste, equipment and listening conditions.
- Can we objectively measure attributes of the piece of music that will consistently and correctly give us a measure of it's overall quality?

Aims of the Study

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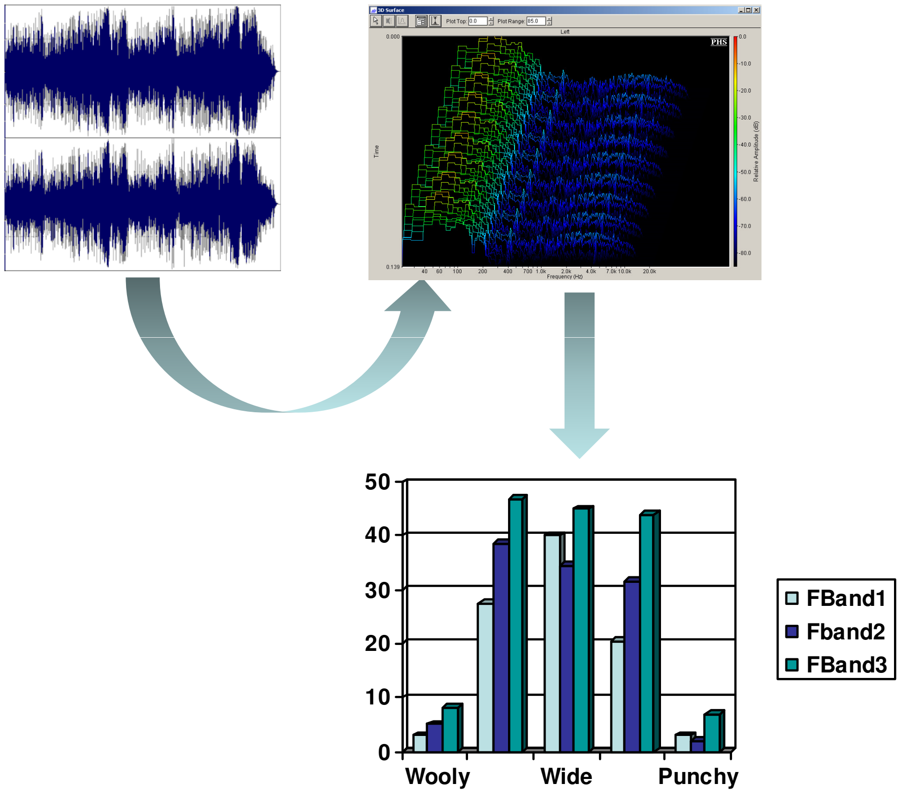
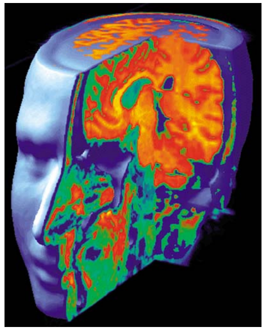


Aims

- Analyse produced music using multi-dimensional techniques.
- Identify 'attributes' of an audio signal that relate to the 'subjective' descriptors.
- Produce consistent tests that prove the link between these attributes and the 'subjective' descriptors.
- Produce tests to objectively measure the overall quality of the produced piece based on these measured attributes.

Aims of the Study

Ultimately, we will create a machine that will ‘listen’ to music and tell us what it thinks of the quality!



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Project In Detail

Project In Detail

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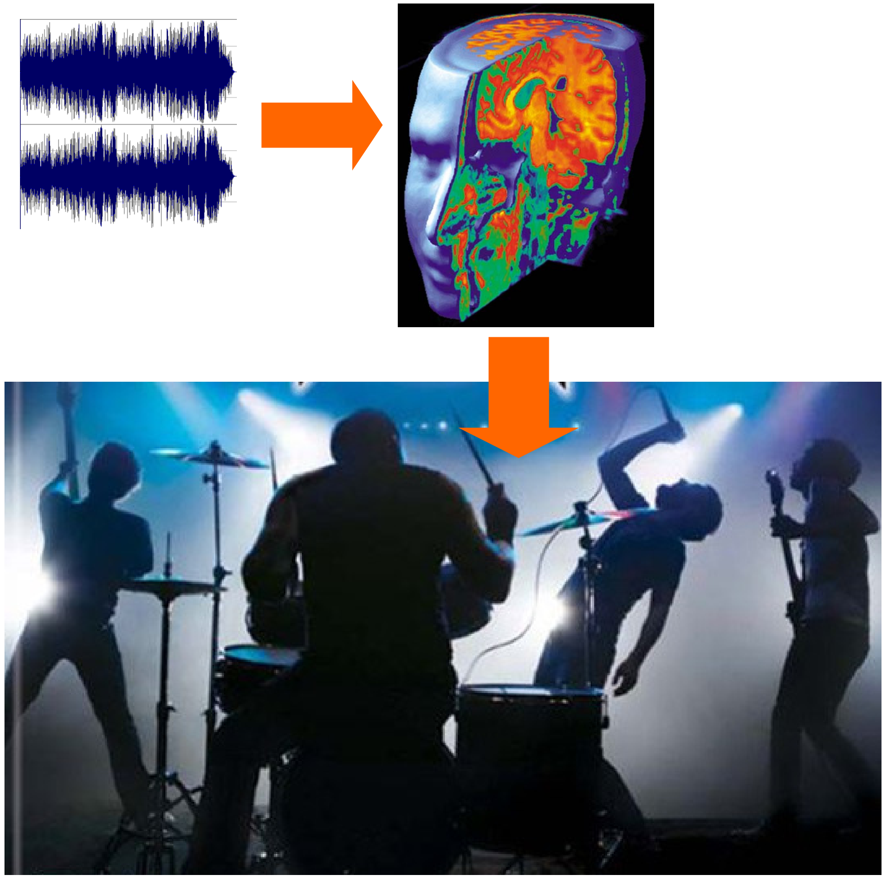
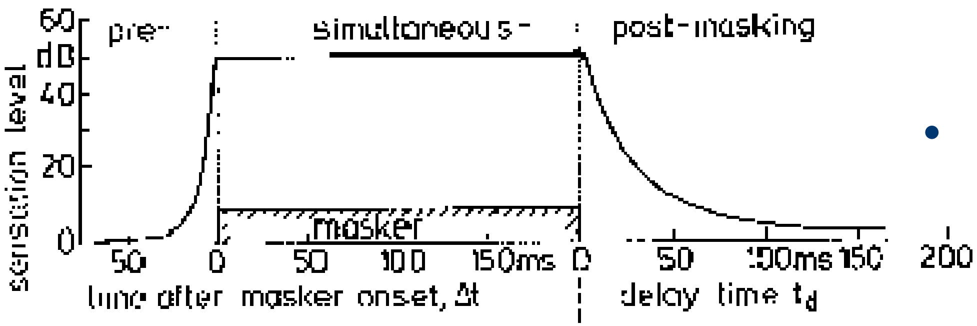
- When we listen to music our brains can quickly distinguish the various components (instruments) that make up the piece.
- If we can hear them that is!
- We hear the musical piece as a whole, but our brains separate the component parts as best it can.

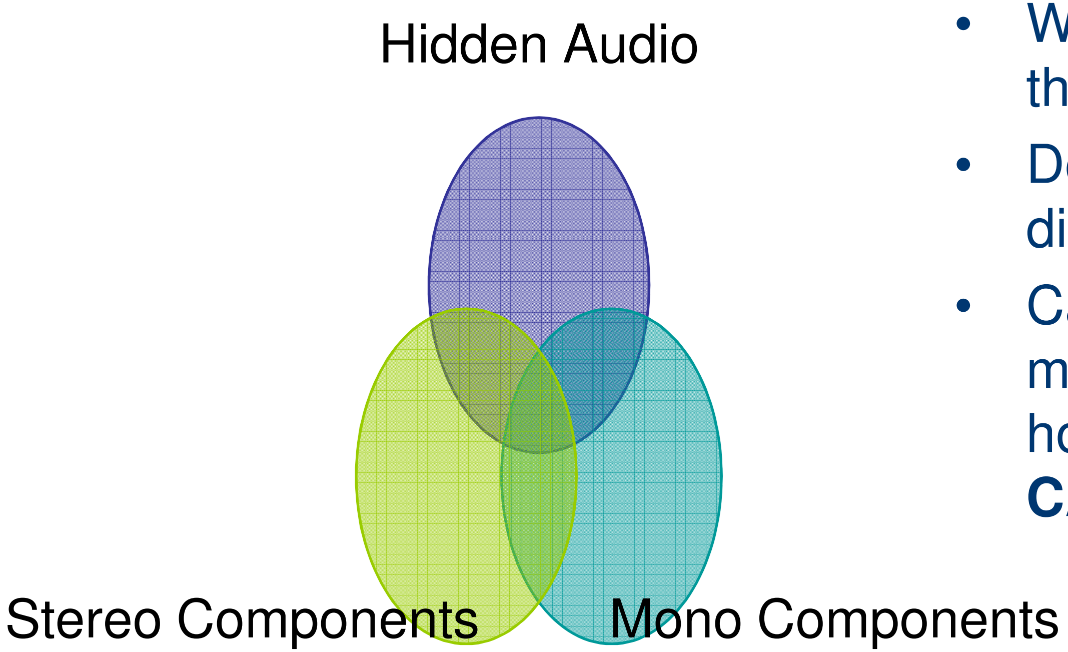


Mixing / Production



- When we mix together different instruments to make up a piece of music, the frequency components of each blend together.
- Importantly, they also blend over time.
- This can lead to both auditory and temporal masking effects, which can effect clarity.

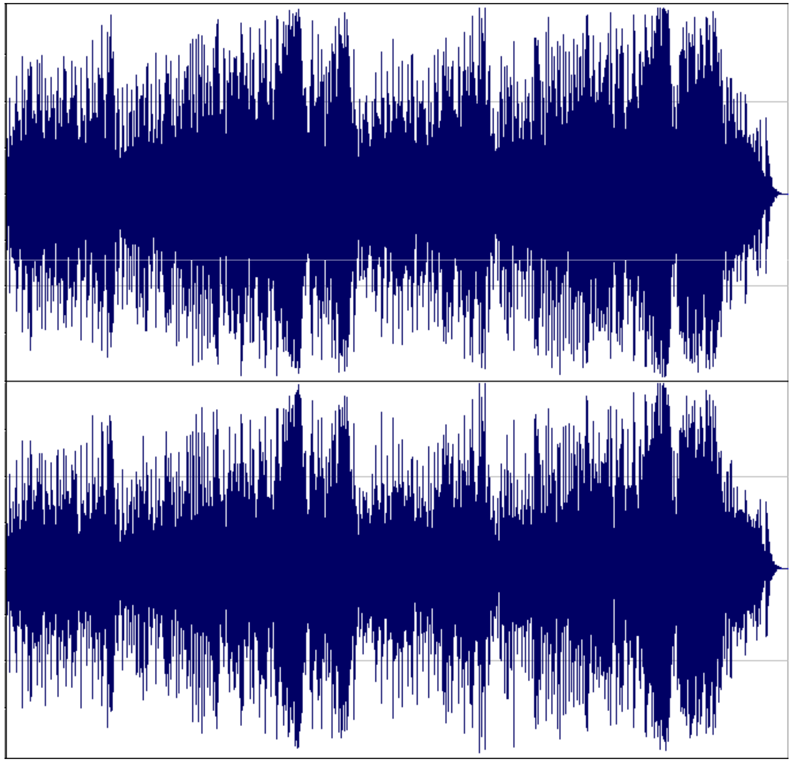
Hidden Audio



- What are our tolerances to these effects?
- Do these tolerances change at different frequencies?
- Can we extract data from a music production that tells us how much information we **CANT** hear?

Analysis Methods

- If we look at this diagram, we can see the amplitude of the audio signal over time, a 2D representation.
- From this we could determine the dynamic range of the signal and perhaps the noise floor.
- We can't, however, see detail and component parts that make up the piece.



FFT, Wavelets..

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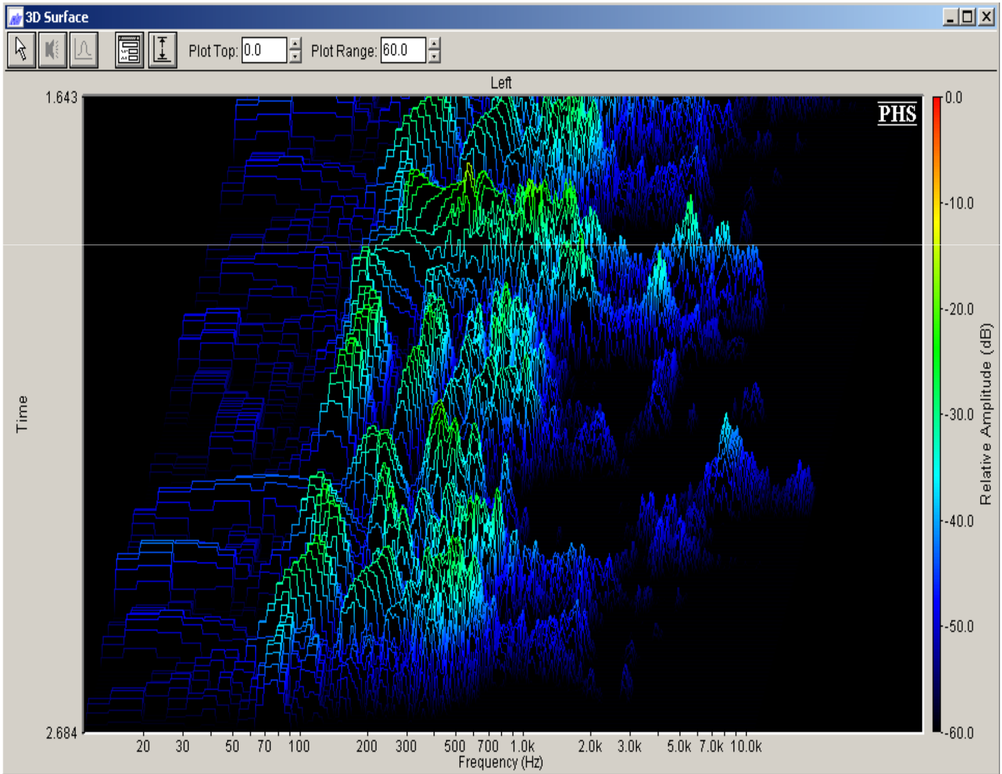
- If we analyse the data in 3D, in this case performing an FFT (Fast Fourier Transform) we can see what makes up the music in detail. We see the data in terms of frequency and amplitude plotted against time.
- Using this additional data, we can perform some detailed analysis.

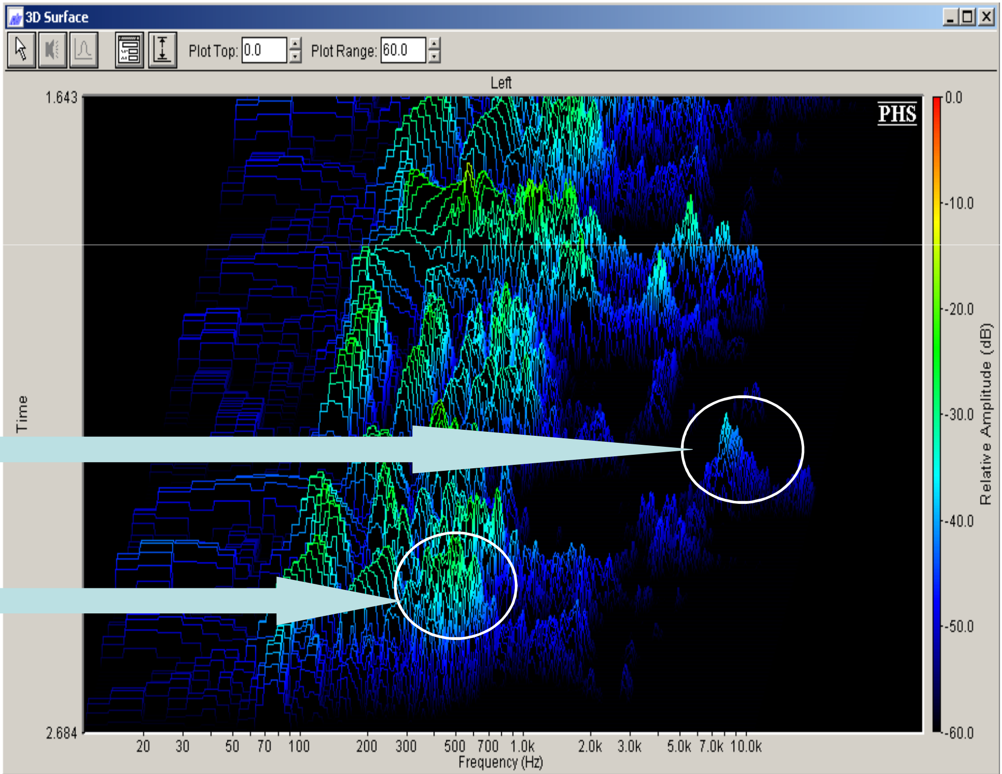


FFT, Wavelets..

- For Example..

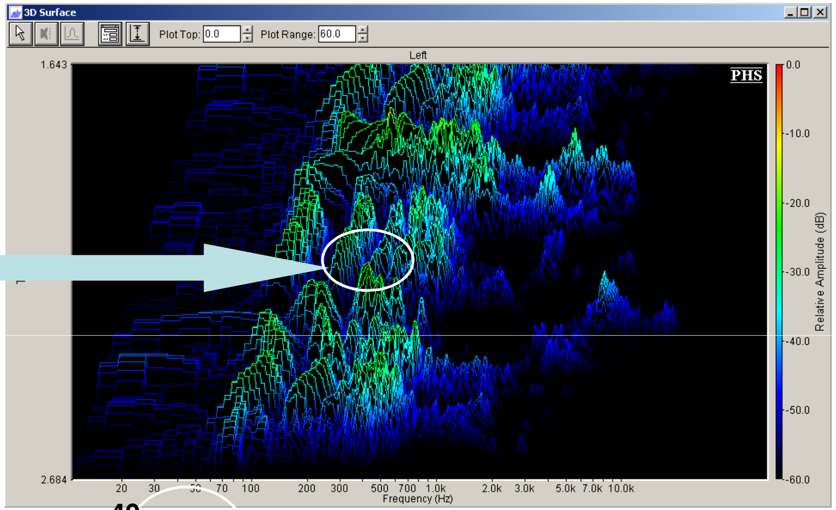
- These frequency components are clearly defined with little chance of temporal or frequency masking.

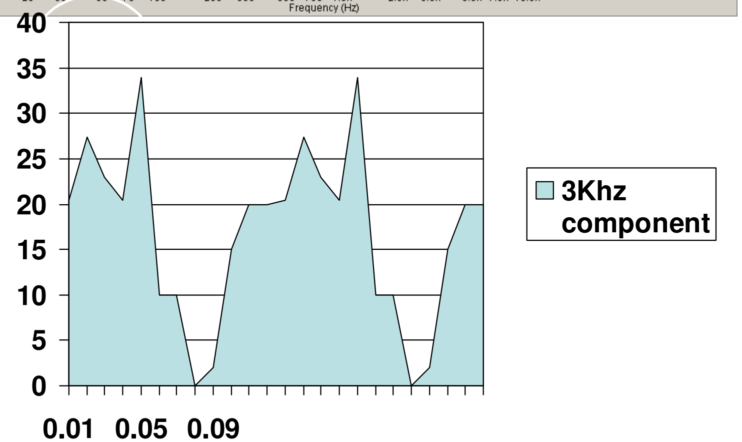
- These components may suffer from masking effects



FFT, Wavelets..

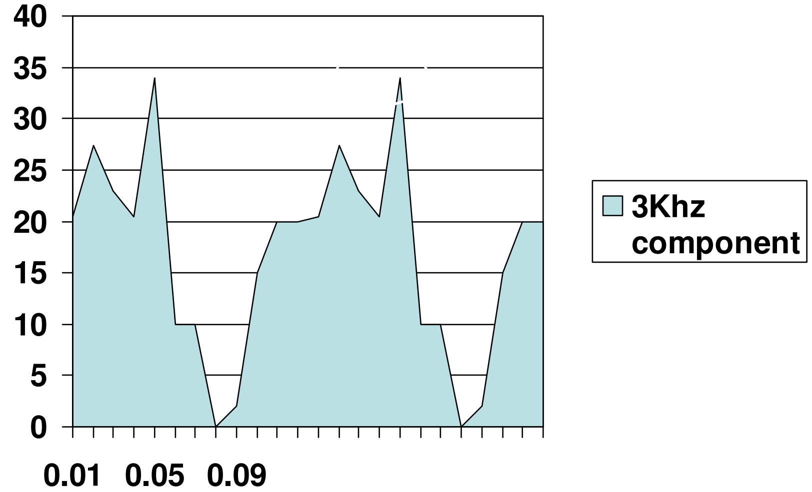
- In addition..
- These gaps can be measured and may have a baring on the overall clarity of the piece.
- Particularly if we consider that no gaps at all could result in permanent masking of adjacent components and/or near DC at a particular frequency component.
- Do the length of these gaps and the frequency bands they exist in have a correlation with the audio quality?





FFT, Wavelets..

- By measuring these transients, we can also identify periodic properties at different frequency bands.
- What are our tolerances to these periods and what impact do they have on our perception of quality?



Multi-resolution Analysis

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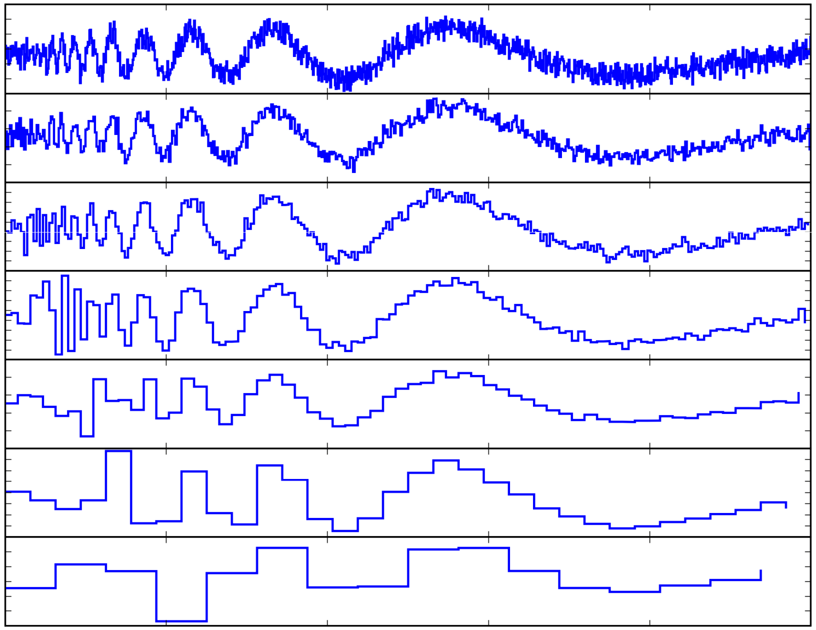
- Because the ‘music’ is made up of a ‘collection’ of complex harmonics we must analyse the piece as a collection.
- In addition, music is often made up of transient and non-periodic components..
- We will investigate the use of **wavelets** to enable multi-resolution analysis to take place. This will give us the ability to look at both time and frequency localisation.
- This project will therefore analyse music in a very similar manner to that of the human brain.



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Overall Audio Quality

Clarity, Dynamics, Stereo Width..

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- Parameters that spring to mind when we describe audio quality are.
- Dynamic range, Signal to Noise, Clarity/Separation, Stereo Imaginary, Punch
- The first two parameters are relatively simply to measure.
- But how about the rest?

Stereo Imagery

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- A mix may contain elements that exist in a ‘stereo’ field. If the stereo field is used effectively, the quality of the piece can be improved.
- Like This..
- But what are the limits? And can they be measured?
- Is it possible to have a piece that is too wide?
- If we split the music into it’s mono and stereo components, we can analyse these separately and more importantly in 3D.
- Our research will incorporate this technique and answer these questions.

Punch

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- What gives a production ‘punch’?
- Is it the bass components? Is it the mid-range components?
- Is it neither of these in isolation?
- Perhaps ‘punch’ is a combination of elements at a single point in time?
- Our research will find these answers.

Summary

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- Identification of objective measures that directly relate to perception of audio quality.
- Multi-resolution analysis.
- Transient analysis.
- Produce an algorithm utilising a number of these measures to represent overall music quality.
- Development of a real-time system for music analysis with respect to quality.

Exciting Prospects

- A machine that can ‘listen’ to music and grade it’s ‘quality’.
- A revolution in Music Technology.
- Commercially, the technology could be used widely for..
- Mastering
- Mixing
- Broadcast quality control
- ..and more!

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