Statistical analysis of classical piano recordings in MIDI format

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Abstract

Musical Instrument Digital Interface (MIDI) recordings of classical piano are analysed for note pitch, velocity and duration. Measured changes in spectrum between notes are not due to the accumulated hammer use of each note. Pitch follows a Gaussian distribution but with some interesting differences. Duration resembles a Weibull distribution. Some differences between composers are noted. MIDI pitch data is compared to a long term spectrum of the same recording in WAV format.

Introduction

In unpublished tests performed on a series of pianos at the School of Music, a trend was noticed in which the C keys produced spectra with significantly higher centroids than the F$^{\#}$ keys. The centroid is the frequency which divides the spectrum in two, with equal energy above and below it.

A high centroid is strongly perceptually correlated with 'sharp' or 'bright' tone [1]. The author wished to investigate the reasons for this result, and two hypotheses were put forward.

The first was that the greater key length of the white keys over the black keys gave more mechanical advantage, leading to a higher hammer velocity.

Due to the nonlinear nature of hammer felt, this would lead to higher centroids [2, 3]. This could be tested by a knowledge of the piano action and measurements of hammer velocity.

The second hypothesis was that some keys were used far more than others, and that over time the keys which were more heavily used would have their hammer felt compressed, again leading to higher centroids [4].

This could be tested by examining the relative amount of wear to the piano hammers, but the author also felt that it would be of interest to study pieces of piano music to find out whether some notes were more prevalent than others.

While a possible method of doing so would be to examine scores by hand, the availability of many pieces of recorded music in MIDI format presents a far less time consuming method.

An internet search for "MIDI classical piano" returns many possible sources of piano recordings which can be used as the raw data.

Although there are issues with accuracy and piece selection, the ability to analyse a very large amount of material in a short space of time represents a significant advantage.

The MIDI file format

The complete specification for the MIDI format can be found in [5]. The MIDI file format is used to record musical performances to be reproduced by a MIDI playback device.

The data in each file is a sequence of note beginnings, endings and velocities. Further data can be encoded, related to tempo, pitch bend, aftertouch and so on.

In general, a MIDI file is much like a musical score or a piano roll, capable of recording all the characteristics of a musical performance, except for the timbre of the individual notes.

Since the production of sound is left to the playback device, no actual sounds are recorded in a MIDI file and the files are quite small (approx. 10 kB for a 3 minute piece). MIDI is used extensively in live and recorded music, as well as on the internet.

For a given piece of music, the MIDI control messages can be quite complex, depending on the style of music and the type of instrument used to encode the file. However the pieces of music used in this study were exclusively for the piano, and gave quite simple MIDI representations.

Each piece could be represented by one or more series of notes, with each note defined by four numbers: time, pitch, velocity and duration.

The time is the time since the start of the piece when the note begins (in seconds). The pitch is the musical pitch of the note, ranging from 0 (C_{-1}, 8.175 Hz) to 127 (G_9, 12557 Hz).

Velocity, where the encoding instrument is capable of recording it, is a measure of the speed or force with which the note was struck, ranging from 0 to 127.

On a keyboard it is the inverse of the time for the depressed key to travel between two contact points. It can be thought of as dynamic level, although the overall sound level and spectrum of the final note depends on the MIDI playback device.

Some keyboards lack this function, in which case all velocities are set to 64. Where velocity is present, it is not standardised between different equipment.

Duration is the length of time that the note is held down, again in seconds.

Expectations and initial guesses

A basic knowledge of music and piano playing allows some guesses to be made about pitch. Firstly, we expect pitch to cluster around the centre of the keyboard, with very high or low notes being less common. Then, more interestingly, we consider the relative frequency of different notes.

To a sufficiently skilled pianist, musical key should be irrelevant: the pianist will be able to play a piece in any key. Also, in equal temperament all keys are equal: for listeners (except those with perfect pitch) there should be no difference in listening to a piece played in E^b or D.

This will however only be valid for pieces written in or for even temperament, which for a large portion of the pieces analysed is not true.

Today, pianos are often tuned close to even temperament but slightly off. Some intervals are made especially pleasant at the expense of others. This can depend on the expected repertoire to be played on each piano.

Because of tuning issues and for other reasons, composers may form emotional connections to certain keys. An interesting list is given by German poet Schubart which is worth reproducing in part here (see Figure 1). Schubart lived at the end

Figure 1: Characteristics of Minor Keys [6, 7]

Key	Description
A minor	Pious womanhood and softness of character
E minor	Naïvety, the innocent declaration of love by a young girl, clothed in white, with a rose–red bow on the breast
B minor	Melancholic womanhood, obsessing about something
D minor	Sound of patience, of quiet waiting for destiny, and of surrender to the divinely foreordained
F# minor	Dark tone
C# minor	Repentant lamentation, the sigh of unsatisfied friendship and love
G# minor	A grumbler/misery, a heart pressed almost to suffocation, a lamentation that sighs into the Double Cross, a difficult battle; in short, the colour of this key is everything that is very hard and laborious
Eb minor	A feeling of disquiet for all the deepest compulsions of the soul; of inwardly brooding despair, of blackest gloom, of bleakest morale
G minor	Dissatisfaction, uneasiness, resentment, listlessness
C minor	Lamentation of unhappy love
F minor	Deep gloom, the lament of the dead, miserable moaning and the yearning for death
Bb minor	Moaning, reproaches against God and the world, preparation for suicide

of the 18th century so he was likely describing just temperament rather than even temperament.

Characters of certain keys are probably less pronounced in the piano compared to other instruments, as on a piano change in timbre is gradual over the entire compass.

In many other instruments, change in timbre comes in jumps, such as on a violin between C# on the lowest string to D played open on the next. Also, composers who compose at the piano will likely compose music that 'fits well under the hand' for the piano. So certain keys may be more common because of the layout of the keys and the shape of the hand.

For a major scale, we expected the relative importance of the degrees of the scale to be something like 1, 5, 4, 6, 3, 2, 7. This is related to the consonance of those intervals with the tonic, as shown in Figure 2.

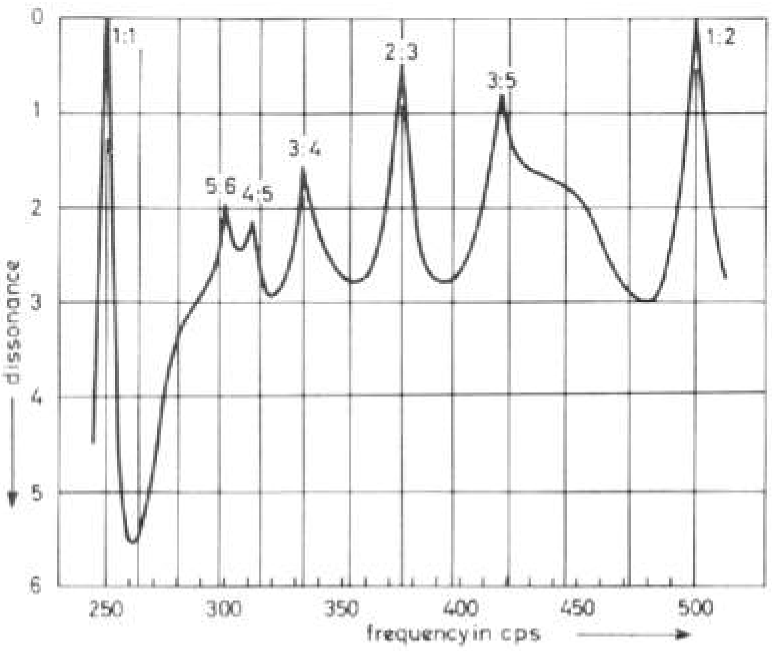

Figure 2: Consonance between a complex tone at 250 Hz and another variable frequency complex tone [8]

Thus, white notes should be more common than black keys. Use of minor keys should make this less pronounced, due to the sharpening and flattening of the sixth and seventh notes under different circumstances.

Considering the number of different factors at play, it is difficult to predict what keys and notes will be more common.

MIDI data analysis

Choice of musical pieces

All pieces used were found on the internet. Only piano pieces were used. At the time of writing, 312 files totalling 1.2 million notes were included in the analysis. The intention was to have a range of material similar to what would be played on the pianos that were originally tested.

Thus classical pieces were favoured, particularly those from the period 1600–1900. Well known composers were also favoured, particularly those such as Chopin who composed extensively for the piano.

There were many possible problems with the MIDI files. Some were corrected for, such as removal of notes with extremely long duration.

Other problems such as a transposition of key from the original, or simple inaccuracies in data could not be corrected and so there is a small amount of erroneous data in the sample.

Matlab algorithm and error checking

Each MIDI file was analysed as follows: the MIDI data was loaded into Matlab using a routine developed by Cemgil [9]. The data for note pitch, velocity and duration was extracted.

As noted above, there is no standardisation between different MIDI devices for velocity data. So it was decided that this data should be ignored for the rest of the analysis.

n addition, any notes of duration longer than one second were removed, as sometimes notes could appear to be stuck on with durations of 30 seconds or more. The decay of piano tones means that relatively few notes are written with durations over one second.

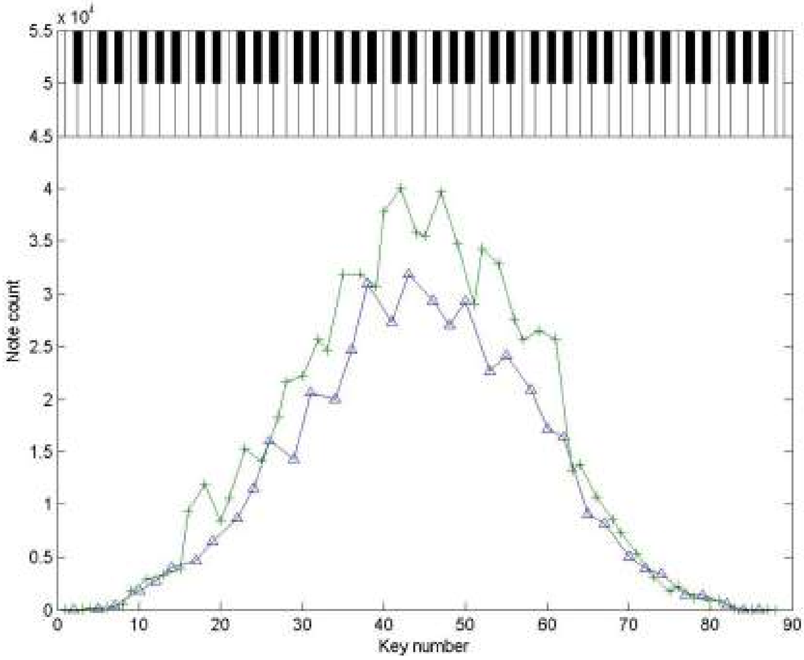

Figure 3: Frequency of occurrence of black and white notes

Statistical tests

Once the data was prepared, standard tests such as mean and standard deviation were applied.

In addition various one and two dimensional histograms and plotting routines were used to show overall characteristics of the data.

Each of these tests could be applied to the data as a whole or to the pieces from one composer only.

For each piece, an attempt was made to find the musical key in

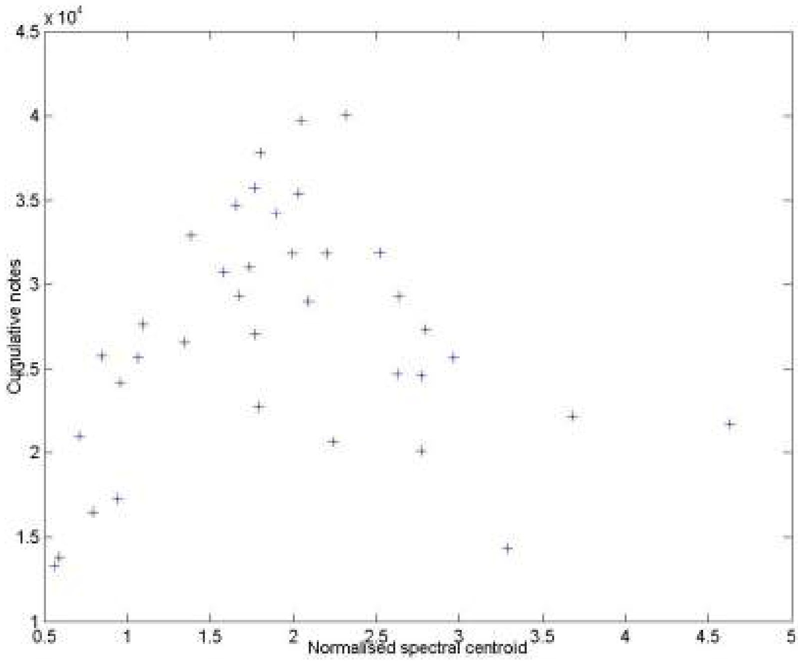

Figure 4: Comparison of recorded centroid of a heavily used piano and accumulated MIDI notes

which it was written, by finding the most frequently used note (mode of pitch modulo 12).

However this proved to be difficult to do as the tonic is not necessarily the most common note, and many pieces contain key modulations which could not be tracked.

Additionally, an attempt was made to assess the frequency of musical intervals. This was done by taking the difference between successive entries in the list of pitches.

The intervals were split into harmonic (simultaneous) and melodic (successive). In general this simple algorithm had problems if the pieces had polyphony greater than two, that is, almost constantly.

Comparison of MIDI and WAV data

Three pieces, Beethoven's Seven Bagatelles (Op. 33), Eleven New Bagatelles (Op. 119) and Six Bagatelles (Op. 126) recorded by Jenö Jandó [10], recorded in WAV format were analysed for comparison with the same files in MIDI format.

The recording was in 16 bit stereo at 44.1 kHz. Power spectra were taken from overlapping windows, and these were averaged over the length of the recording, with spectra from both channels added together. A 16,384 point Hanning window was used.

Centroid

Accelerometer recordings of a heavily used Kessels piano were made at 48 kHz, from C3 to C6.

The FFT of the onset portion of each note was recorded. A 16,384 point Hanning window was used. Centroid was found by $\sum Af/\sum A$, where A is the magnitude of each frequency bin [1].

Analysis of results

Pitch

The pitch results cluster around the centre of the keyboard.

The very high and low keys are used relatively little. The distribution is close to Gaussian, with mode D4, mean E4 and standard deviation of 13.8 semitones.

The most common notes in most octaves are D, G and C which are 10% more common than average, while the least common are $C^\#$ and $F^\#$, 8% and 10% less common respectively.

The white keys are slightly more common than the black keys as shown in Figure 3. Most white keys are between 5-15% more common than the neighbouring black keys.

An exception to this occurs in the high treble, from A^b_6 to E^b_7, where the black keys are more common.

This may be because when stretching out with the right hand they are easier to reach.

A similar but smaller effect occurs in the bass for A^b_2 and B^b_2.

Centroid and pitch comparison

The original intention of this study was to find whether the accumulated felt compression differed between notes, leading to differences in centroid. Figure 4 shows that there was no correlation between the measured centroid and the relative amount of use for each key.

The centroid differed between adjacent notes by a maximum of 30%, with a mean of 12%. The differences were not as large or regular as had been previously found, calling into question the method of measuring centroid previously used.

Duration

The list of durations was sorted into bins of 50 ms each. The mean note duration was 220 ms, and the mode fell somewhere between 50 and 100 ms. The distribution is clustered towards the shorter durations. The distribution resembles a Weibull distribution, which is often used to assess the lifetime of mechanical and electrical components. Figure 5 shows the two dimensional histogram of pitch and duration. The notes cluster between 50 and 200 ms and around the notes from G3 to A5.

Intervals

Plomp and Levelt [8] gave a graph reproduced in Figure 2 showing the subjective consonance between two complex tones. Consonance is highest where the fundamentals are in ratios that can be expressed in small integers. This is interesting when compared to the frequency of intervals from the pieces analysed.

As shown in Figure 6 the most common harmonic interval was the minor third, followed by the octave, major third, fourth and fifth. Intervals of 1 and 11 semitones, which are subjectively very dissonant, were uncommon. But interestingly, the flattened fifth (6 semitones) was almost as common as the major sixth, despite being considered dissonant in comparison.

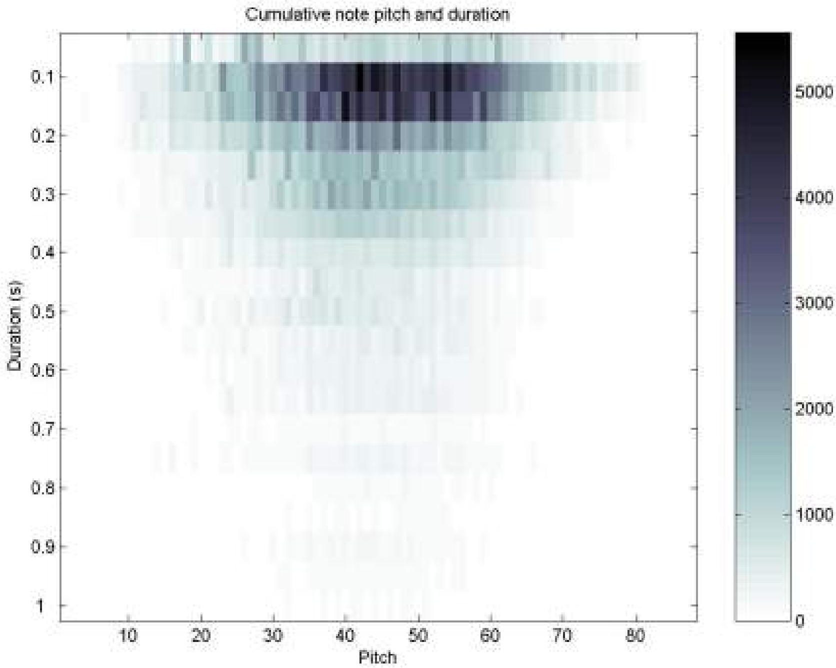

Figure 5: Two dimensional histogram of pitch and duration

Melodically, small intervals were far more common than large intervals, with the exception of the octave. The most common was unison, or repetition of the same note. Added to the trend for small intervals was the preference for consonant intervals such as the fourth and fifth.

Composer specific results

There were a few composers for whom there were enough pieces collected to draw relatively meaningful conclusions: Chopin (48 files), Schubert (41 files), Beethoven (31 files), Scarlatti (20 files) and Mozart (17 files).

Mozart and Scarlatti had significantly higher average pitch (both G4) than the other composers, who averaged D4. Schubert didn't like E^b much but apart from that used all notes most evenly out of the composers studied.

Mozart and Scarlatti both favoured G, C and D, and stayed well away from the black notes. Beethoven had a small preference for C, F and G. Chopin used A^b and E^b most often.

An analysis of the melodic intervals used by each composer shows that while most favoured the same melodic intervals as described above, Chopin was fond of larger intervals such as fourths, fifths and sixths. Meanwhile Mozart and Scarlatti made less use of note repetition, but instead favoured stepwise (two semitones) motion. Harmonically, Schubert and Chopin used a lot more diminished fifths than the other composers, while Scarlatti used a large number of major sixths.

It is quite likely that some of these differences can be attributed to differences in instruments at the times when each composer lived. In chronological order, we have Scarlatti, Mozart, Beethoven, Schubert and Chopin.

The pianos of Mozart and Scarlatti's day were relatively small and lacked power in the bass. Improvements in materials and construction meant that pianos available to the other composers were relatively richer and stronger

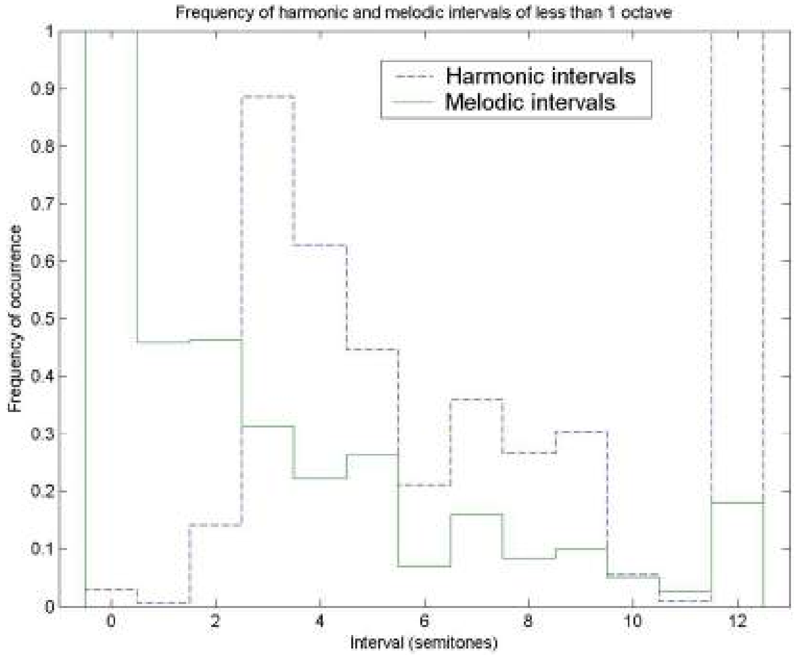

Figure 6: Histogram of harmonic and melodic intervals

in the bass range.

This might account for the increased use of the high registers by the earlier composers. In addition, the use of just temperament would mean that keys relatively close to C in the circle of fifths would have sweeter harmonies, encouraging the earlier composers to use those keys.

MIDI and WAV comparison

The MIDI pitch data and the averaged WAV spectrum shown in Figure 7 have somewhat similar shapes, although the WAV spectrum extends further to high and low frequencies. The MIDI data only includes the fundamental of each note so it should be lower at high frequency. The WAV data could be expected to be lower at low frequency, the fact that it is not suggests that there is energy in the piano notes below the fundamental.

The MIDI data peak is lower in frequency and flatter. The peaks in the WAV spectrum are at the frequencies matching the fundamentals of the piano notes (when the Railsback stretch is taken into account [2]) but the height of those peaks does not match the height of the peaks in the MIDI data.

It would be possible to construct spectra for each of the notes in the MIDI dataset based on pitch, velocity and duration. Averaging these would give a spectrum that should match that found from the WAV data.

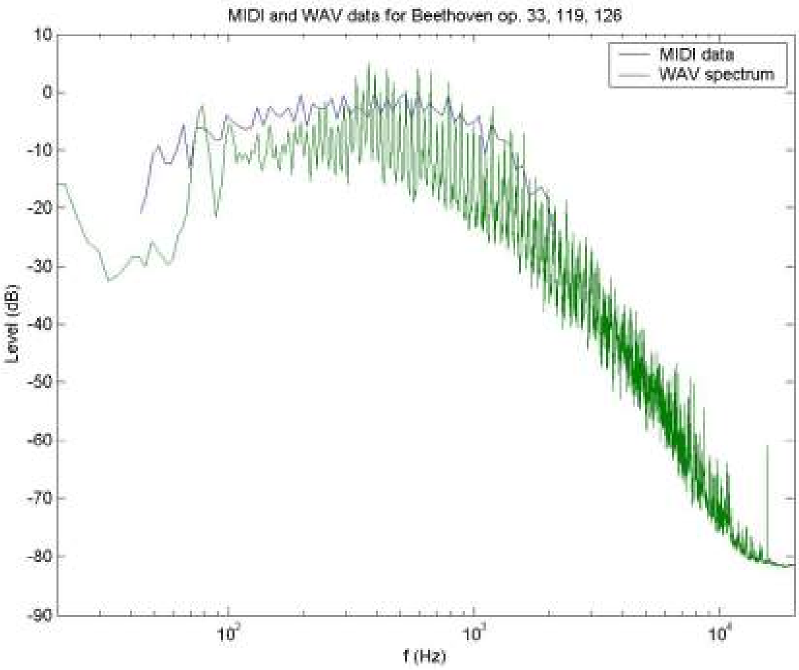

Figure 7: Comparison of the same pieces in MIDI and WAV format

Conclusions

- Differences in centroid are smaller and less regular than previously measured, and are not caused by accumulated compression of hammer felt
- Pitch follows a Gaussian distribution but with some amount of preference for notes common to keys closely related to C major on the circle of fifths
- Short duration notes are more common (50–200 ms)
- Minor thirds and octaves are the most common harmonic intervals
- Unison was the most common melodic interval
- Composer's choices of key and register were affected by the pianos available at the time.

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Noise forces birds to sing louder

Big-city noise levels prompt birds to sing louder, according to research by German ornithologists. The study of

free-ranging nightingales in and around Berlin showed that these chocolate male birds "singing in the dead of night"

had to raise their voices in order for females of their species to hear them.

An analysis of sound pressure levels revealed that males at noisier locations sang with higher sound levels than birds in other territories.

NZ Herald

The Making of a Sound Meter

Jim Weir

Jim Weir is the Product Manager representing environmental products line of Brüel & Kjær in North America. During his 21 years with the company he has been involved in sales, application support and management activity.

Do you remember the first time you were asked to measure how noisy something was? If you do, you'll more likely recall pulling a sound level meter out of the equipment cupboard. You may have skimmed through the manual, and twiddled a few knobs. You probably stared at an analogue meter needle bouncing up and down, and I bet you whistled...

My first experience as a young avionics engineer at the Learjet Company was just like this. I was asked to evaluate some cockpit noise levels. My visit to the equipment cupboard brought me face to face with a pale green instrument that was a bit intimidating, if only by its size. It barely fitted in my large hands, and two hands were definitely required.

The sturdy instrument offered a tapered top to minimise reflections that may disturb the accuracy, and had only two knobs, making it easy to figure out.

The top 'range' knob was a clever double attenuator that allowed me to set the measured level so that it fell into the instrument's massive 20 dB display range.

It wasn't long before the measurement was complete, with the stepped octave filter determining that the highest noise level was in the 500 Hz octave frequency band, and according to Beranek, loud enough to interfere with speech communication in the cockpit.

History

The instrument I used was the first generation sound level meter by Brüel & Kjær, the Type 2203, which in 1965 changed the way sound meters looked, and in many ways how we used them. Massive grey boxes with gooseneck microphones, usually from General Radio, were its predecessors.

I joined Brüel & Kjær in 1983, when the second generation of sound level meters was being introduced, and the first microprocessor controlled model, the Type 2230, came onto the market. Just a few years later, the programmable Type 2231 followed.

The shape of the meters was similar to the older meters, though now they fitted readily in one hand, letting you use your other hand to move the controls to display the many parameters stored in the SLM's memory.

Start a measurement and you could switch between maximum, minimum, and L_{eq}—the real average level.

Technology, like rust, never sleeps.

Along with that technology, the knowledge of the acousticians started to creep into standards, and the requirement for sound measurements grew in scope and scale. By the mid 1990's, statistical parameters like L_{DN}, L_{10}, and L_{90} became common measurement requirements, and no longer was it sufficient to measure values over a fixed time period. Noise monitoring was now a function of the sound level meter, not just a noise terminal. At Brüel & Kjær, Multi-D™ measurements of level-v-time-v-frequency was born in the 2260 Investigator platform almost a decade ago. Now a digital signal processor and a microprocessor collaborated to fill up megabytes of information the noise consultants could use for diagnostics and analysis.

Interestingly, Brüel & Kjær used this third generation of product to introduce the first new shape in sound meters. The display section was moved to the more practical user end of the meter, closer to the failing eyes of ageing acousticians!

The control buttons moved towards the middle of the unit so it could be gripped and operated by one (large) hand. The sleek distinctive sweeping shape let the sound waves flow towards it as smoothly as an America's Cup sailing boat slips through the ocean.

Brüel & Kjær used the latest available technology when introducing the Type 2260 Investigator. This, coupled with flexibility of application-based measurement technology, has enabled the instrument to persevere in a competitive market, with sales growing in each successive year. In 2003, Type 2260 platform sales achieved their highest growth ever worldwide.

Planning ahead

As innovative as a company can be, it is useful now and then to get a reality check as to the direction you are moving. Sometimes, this comes from a competitor introducing a new technology, waking you and customers up to 'the new thing'. The reality check may also come from an unexpected drop in sales, when customers' needs drift away from the products and services you provide.

A few years ago, the environmental market group at Brüel & Kjær initiated a reality check of our own. We called it the Handyman Project. New technologies such as laptop computers and palm PC's were now capable of serving in the portable sound measurement market. We asked ourselves what our customers wanted to have in a sound measurement analyser to perform their jobs.

More important, actually, is that we went to the customers and asked them that question. We enlisted sixty customers considered to be expert users of sound meters and interviewed them about their job function and work processes. In small groups we mediated discussions about platform type, workflows, integration and reporting... asking for example: 'Do you want to bring your laptop into the field?'.

We then engaged in a brainstorming session with these users, letting them come up with ideas, characteristics and features. We made a feature puzzle, with each expert using a stack of tiles, each one representing a feasible instrument feature or characteristic (such as 'colour screen'), and a playing area. They then had to fill the playing area with tiles. Easy enough, except that there were more tiles than space on the playing area, so a choice had to be made. The result was a set of chosen features. The playing area was then halved, and the process repeated (using the same set of tiles). The playing area was halved once more and the tiles placed again. The result for each member was therefore a description of three instruments representing the 'nice to have', 'should have', and 'must have' features.

Time to start

About the time we were wrapping up the Handyman research project, we were getting one of those unexpected reality checks. We discovered that whilst a vast number of our customers were happy with their existing noise measurement analysers, others were asking for additional features

Getting the grip right - indents made by the combined holds of various hands in a soft clay prototype were modelled in a computer-aided design system that could also perform acoustic calculations.

such as real time frequency analysis and a wide 100 dB dynamic range. Now was the time to put the Handyman research into practice.

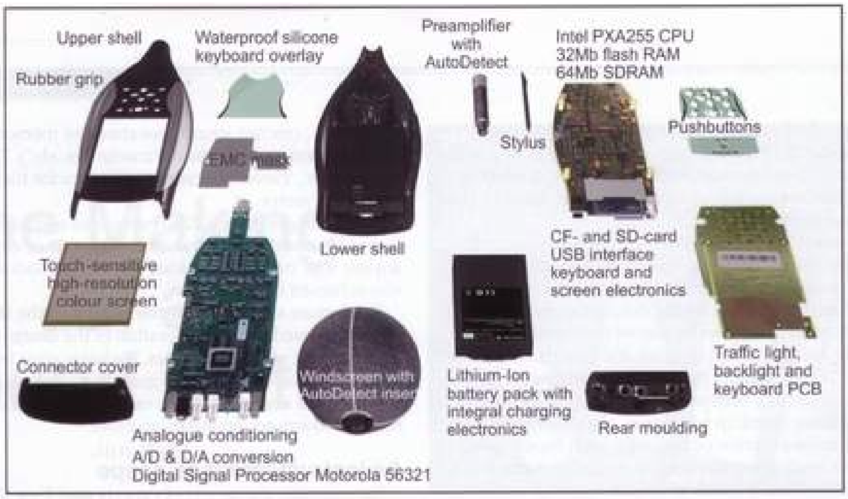
During this project, a re-occurring set of descriptors continued to show up in our discussions. We would hear: 'It has to be easy to ... (hold, use, set up, calibrate, etc.) or: 'Our (data, measurement, use,) has to be safe'. 'It would be clever if it could... (record sound, use standard memory cards, accept sound and vibration transducers, etc'). The words ‚easy', 'safe', 'clever', became the mantra for the development of the new meter.

When designing Type 2250 every idea and feature was tested against the question: 'Is it easy, safe or clever?'. If the answer was 'no', then the idea was either modified until a yes was achieved or scrapped.

The feature set chosen by the experts in the Handyman project allowed rapid acceleration of the design and development of the new meter. We knew what features we had to include, and we had a guideline to use to define the technologies customers were expecting for the next midrange platform sound meter/analyser.

An instrument takes shape

For example, the panels of experts said Type 2250 should be safe to hold, so an instrument with a pre-formed handle like that on a power-tool would be ideal. Unfortunately, this is not acceptable acoustically. You can wave goodbye to Class 1 rating if you stick a pistol grip on a sound level meter. There was obviously a conflict here, so instead, a streamlined model of the proposed instrument was made in soft clay, and then given to a large number of people to hold.



The components packed into the Type 2250 sound meter

Over time, the combined grips of big and small hands, with long, short, wide or narrow fingers, made indents in the model (see picture). This gave an average grip shape which was then modelled in a computer-aided design system that could also perform acoustic calculations. These showed where the grip shape caused the frequency response to fall out of tolerance. By iteration, the shape was modified to make the frequency response correct. When done, a real solid model was made from a polythene block, and tested on the same people. This revealed that the grip was good, but still suffered from small aberrations. So the whole process was repeated, the final result being the shape that Type 2250 is clothed in today.

Sandy McDonnell of the renowned McDonnell Douglas Aircraft Company, once said of the development of a new aircraft: "When the weight of the paper matches the weight of the aeroplane, it will fly."

Well, a sound meter isn't a DC-10, but we had a weight of features to fit into our little SLM-to-be. And it had to be Easy, Safe and Clever. From the experts' input it was obvious that a dedicated handheld platform was preferred over hybrid Palm-PC or Laptop data acquisitions formats, because we can make it environmentally rugged, and we could control the way the user operates the device.

It was decided early that a colour touch screen was a convenient user interface. It would be clever to include screen formats with high contrast for daytime measurements, and a low contrast night vision mode for measurements in the dark. Also, you may need to be one-handed to control the instrument, so buttons can be used to navigate the functions of the touch screen, and it is clever to allow you to backlight those buttons for easy night-time operation.

Technological developments allowed us do some things nobody has done before to make data safe. We can now measure from the standard microphone's noise floor to 140 dB for broadband measurements filters (A, C, Z) and also maintain that same dynamic range for the octave and third-octave measurement bands. Now you are unlikely to overload or under-range your measurement by mistake. Technology also brought us the latest low power consumption DSP and microprocessors to give extended battery life, while the latest battery technology allows thousands of recharge cycles from a single battery.

One unique feature that came from the Handyman project was the Type 2250 user login that lets you customise and save the set-ups and measurement templates you use, while colleagues can use their own personalised meter configurations. As the experts requested, the instrument is easily set-up and synchronised with a PC using the included software, making it even easier to download and upload measurements and settings.

What's inside the Type 2250?

Perhaps the most daunting task was that of the hardware designers to fit all this 'stuff' into the marketing teams' easy-to-hold compact sound analyser package. USB, Compact Flash interface, SD memory slot, signal input (with accelerometer power supply), trigger connector and a standard headphone mini-jack all had to fit on the rear face alone. The Type 2250 had to be water resistant, retain its look and feel over a wide temperature range, and meet the demanding standards of your next generation Brüel & Kjær sound level meter.

Turn the meter on, touch your log in ID, press XXXXXXX, that's it! You are measuring the way you want - Easy, Safe, Clever!

You can take a tour of the new Type 2250 at www.type2250.com

Acknowledgements: Julian Simpson and the rest of the 35+ member Brüel & Kjær Denmark Marketing and Development team for their information, support and pictures. ❑

New Products: Brüel & Kjær Type 2250

The type 2250 is the innovative, 4th generation, hand-held analyzer from Brüel & Kjær. The design philosophy is based on extensive research which concluded that the instrument should be easy and safe to use, while at the same time incorporating clever features. The platform has been specially designed to be adaptable to future needs, while meeting the ergonomic requirements of users.

Type 2250 contains a set of software modules, including frequency analysis and logging, that are enabled through easily activated software license keys.

The combination of software modules and innovative hardware makes the instrument into a dedicated solution for performing high-precision measurement tasks, in environmental, occupational and industrial application areas.

As a result, you get the functionality you need now, plus the option of opening up for more functionality later - and your investment is securely protected. ❑

Type 2250 – Features

- Clear status indication using 'traffic light' indicators
- Easy to find and review data
- Touch-sensitive colour screen
- Rechargeable Li-Ion batteries
- Secure Digital and Compact Flash memory-cards
- USB computer interface
- 120 dB dynamic range
- 3 Hz – 20 kHz frequency range
- Real-time analysis in 1/1- or 1/3-octave bands (optional module)
- Logged time history for later analysis (optional module)
- Personalised setup
- PC software
- Automatic windscreen detection
- Standard high-speed interfaces

New Products: CEL-430

The **CEL-430** is an easy to use instrument designed to undertake the measurement requirements of Noise at Work regulations. It also complies with the latest IEC and ANSI international standards for sound level meters.

Just switch on the instrument, auto -calibrate and start measuring with one of the pre-defined setups for either European, US or German standards. By implementing the latest digital technology, the meter has a single measurement range so no adjustment is required, ensuring the highest levels of performance with all noise sources.

The large display and logical keys combined with the unique automatic-calibration function and single wide range make the CEL-430 easy to use.

The pre-configured setups within the instrument simultaneously measure all the parameters required by the action levels in the Noise at Work regulations, including time-average, peak and maximum levels. ❑

Key Features:

- Designed specifically for Noise at Work measurements.
- Easy to use switch-on-and-go functionality.
- Pre-configured setups for EU, US and German Noise at Work regulations
- Unique automatic calibration function.
- Single measurement range 140dB, no range adjustment required.
- Data storage and download PC software available.
- Class 1 or Class 2 models available.
- Output to recorders.
- Battery life greater than 15 hours.

New Products: Sonatex™

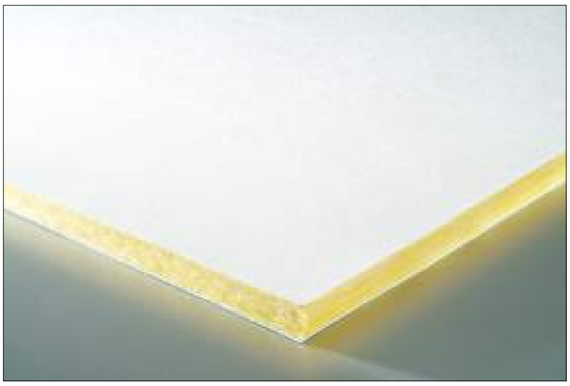
Asona Ltd, a New Zealand manufacturer and marketer of acoustical finishes has recently introduced a revolutionary new patent pending composite facer material called **Sonatex™ .**

Sonatex™ is designed as a high performance facer panel for ceiling and wall absorbers and is manufactured at Asona's Auckland factory using the latest in non-woven glass mat technology. Sonatex features an engineered composite micro-porous structure for controlled air-flow resistance, durability, non combustibility and dimensional stability.

Highly porous to sound, it's semi-rigid form acts as a panel absorber to boost mid and low frequency performance: NRC 0.55.

Absorption is increased with the addition of an absorber material on the back. For example, 25mm of 48 kg/m^3 glass wool: NRC 0.95, 75 mm of 35 kg/m^3 glass wool: absorption is increased to NRC 1.05.

At 250 kg/m☐, Sonatex™ is a high density facer that provides superior handling and durability characteristics



compared to light weight glass tissue faced mineral fibre or soft fibre acoustical panels. It's resilient composite structure resists impact and penetration damage from blunt and sharp objects, it will not shrink or warp in humid conditions, resists cracks and chipping and has great 'bounce back' under load, making it the ideal facing for absorber panels in schools, offices, and sport facilities where a durable long lasting acoustic finish is desired.

Sonatex 250 is the facer panel for Triton 25™ , Triton 75™ , Duo Hi-CAC/NRC™ and Diffusion™ ceiling panels, and as an acoustic impact facer for Fabwall™ and Sound-Soft™ stretched fabric wall lining.

Sonatex is also a highly adaptable material that can be digitally printed, hot stamped with designs and colour, die cut, folded or thermoformed into acoustic shapes and structures.

- Recent projects include: Greenlane Hospital Audiology department—Triton 25™
- Central Auckland Hospital Clinical Education lecture theatre—Sound Soft™ stretched fabric wall absorber, Fabwall™ and gypsum reflector panels.
- Birkenhead School—Triton 25™
- Hoyts cinemas—Fabwall™
- Wright Engineering—Duo High -CAC/NRC™
- Gypsy Tea Rooms wine bar on 455 Richmond Road, AKLD—custom digital printed absorber ceiling.

With lamination capability, Asona Ltd also produces a range of vinyl faced hygiene ceiling panels, tissue

faced attenuator panels, decorative finishes and custom acoustic solutions. Asona imports and markets Danoline™ perforated gypsum linings, Atkar perforated fibre cement, MDF, Ply linings and Royal mat floor impact isolation panels.

Asona welcomes the opportunity to work with designers in creating acoustical comfort in the built environment. ❑

CRAI Ratings

Another opportunity for a multiple rating of a restaurant in this issue. George Dodd was efficient enough to organise rating forms for all the attendees at the Society Conference dinner in Wellington in early November 2004.

The dinner was held at "88", coincidentally at No 88 Tory Street! The food was superb, but with a large group of people present, communication was impossible beyond the person immediately next to you (my personal view!).

Interestingly, despite this, one diner rated the venue as high as 4 ½ stars, with others rating it as low as 2 stars. Perhaps not surprisingly, the 2 stars dominated, with the average from 35 responses being 2.2 stars (rounded to 2).

It seems that I'm the only one who has dined out in the past few months, because the contributions to this column have completely dried up. Please keep us in mind. Perhaps you should print out a copy of the form and fold it up small enough to fit into your wallet!

Stuart

Auckland	
Andrea (formerly Positano)	★★★★
Byzantium, Ponsonby	★★★
Del Fontaine, Mission Bay	★★★★★
Dizengoff, Ponsonby Rd	★★
Gero's, Mt Eden+	★★★
Langtons, Onte Tree Hill+	★★★★
Mezze Bar+	★★★
One Red Dog, Ponsonby	★★★
One Tree Grill	★★★
Prego, Ponsonby Rd	★★
Rice Queen+	★★★★
Watermark, Devonport	★★

Queenstown	
Bunker	★★★★
The Cow	★★★
Sombreros	★
Tatler	★★★★

★ Lip-reading would be an advantage.
★★ Take earplugs at the very least.
★★★ Not too bad, particularly mid-week.
★★★★ A nice quiet evening.
★★★★★ The place to be and be heard.

Wellington	
88, Tory Street+	★★
Anise, Cuba Street	★★
Café Pasha	★★★★

Christchurch	
Alchemy Café, Art Gallery	★★★★★
The Bog	★★★★★
Café Bleu	★★★
Caffe Roma	★★★★★
Foo San, Upper Riccarton	★★★½
Green Turtle	★★★★
Le Café, Arts Centre	★★★
Lone Star, Manchester Street	★
Luciano Ristorante, Peterborough Street	★
Red, Beckenham Service Centre	★★★★
The Vault, Cashel Mall	★★★★

Ashburton	
Tuscany Café & Bar	★★★

Note: + denotes rating by more than one person

2005

Mar 19-23, Philadelphia
International Conference on Acoustics, Speech, and Signal Processing.
www.icassp2005.com

Apr 18-21, Saint Raphael
Intl Conf Emerging Technologies of Noise & Vibration Analysis & Control
Goran.pavic@insa-lyon.fr

Jul 11-14, Lisbon
ICSV12
www.iiav.org

Aug 6-10, Rio De Janiero
Inter-Noise 2005
www.I-ince.org

2006

June 26-28, Seoul
Wespac9
www.wespac8.com/wespacIX.html

Dec 3-6, Honolulu
Inter-Noise 2006
www.i-ince.org

Café & Restaurant Acoustic Index Rating Sheet					
Name of Café/Restaurant, including City:					
Date of Visit (Month/Year):					
Visit by: (Optional)					
How many people at your table?:					
Your Age Range:	<25	25-35	35-45	45-60	>60
	A lot				Not at all
	1	**2**	**3**	**4**	**5**
1. How much noise do you like in café's/restaurants?	1	2	3	4	5
2. How much did the level of noise adversely affect your enjoyment of the dining experience?	1	2	3	4	5
3. Did you experience any difficulties conversing with other people as a result of noise?	1	2	3	4	5
4. How much would your experience of noise in this venue adversely affect your decision to return?	1	2	3	4	5
	Almost empty				Full
5. How busy was the café at the time of your visit?	1	2	3	4	5
	Too Loud				None
6. At what level was music playing while you were eating?	1	2	3	4	5

Send your completed form to the Editor, New Zealand Acoustics;

C/- PO Box 4071, Christchurch

Fax: 03 365 8477

stuart@marshallday.co.nz

Society Membership

Membership in the New Zealand Acoustical Society is open to anybody interested in acoustics. There are no entry requirements. Members receive benefits including;

- Direct notification of upcoming local events
- Regular mailing of *Noise News International*
- Reduced charges for local and national Society events
- Priority space allocation for trade stands at society events
- Discounted rates on selected acoustic products

If you would like to become a member of the society, please complete the following form and attach a cheque made payable to the *New Zealand Acoustical Society*.

The Treasurer
New Zealand Acoustical Society
PO Box 1181
AUCKLAND

Please sign me up as a financial member of the New Zealand Acoustical Society.

Name: ______________________________

Address: ______________________________

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Phone: ______________________________

Fax: ______________________________

Email: ______________________________

I enclose a cheque for $ ______________________

Membership is determined on a 2 yearly basis, from September of each even year. Fees payable are currently;

Full Member	$50.00	(per 2 years)
Student Member	$36.00	(per 2 years)
Sustaining Member	$100.00	(per 2 years)

Signed:

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