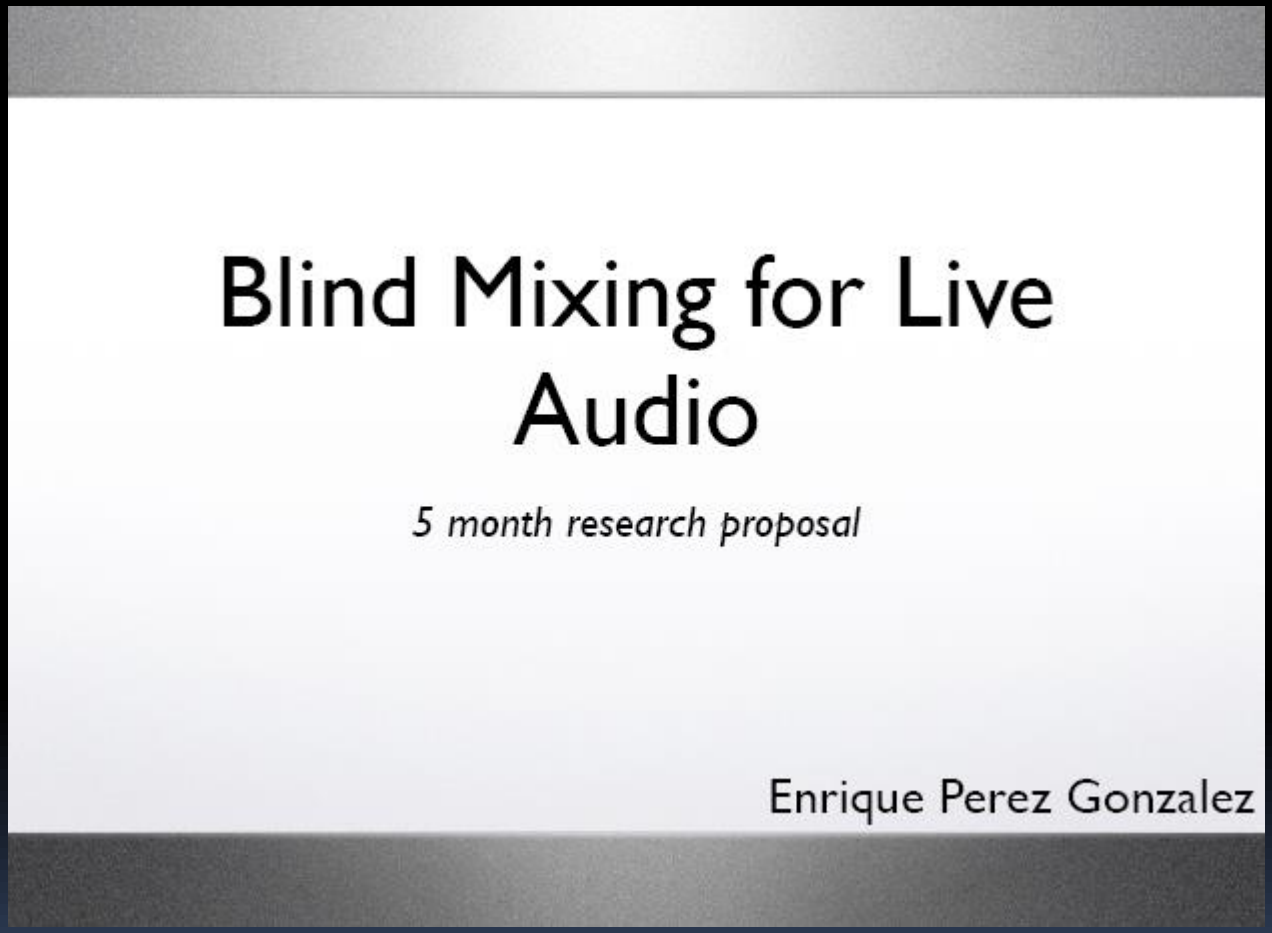
From Basic Academic Research To High-tech Start-up

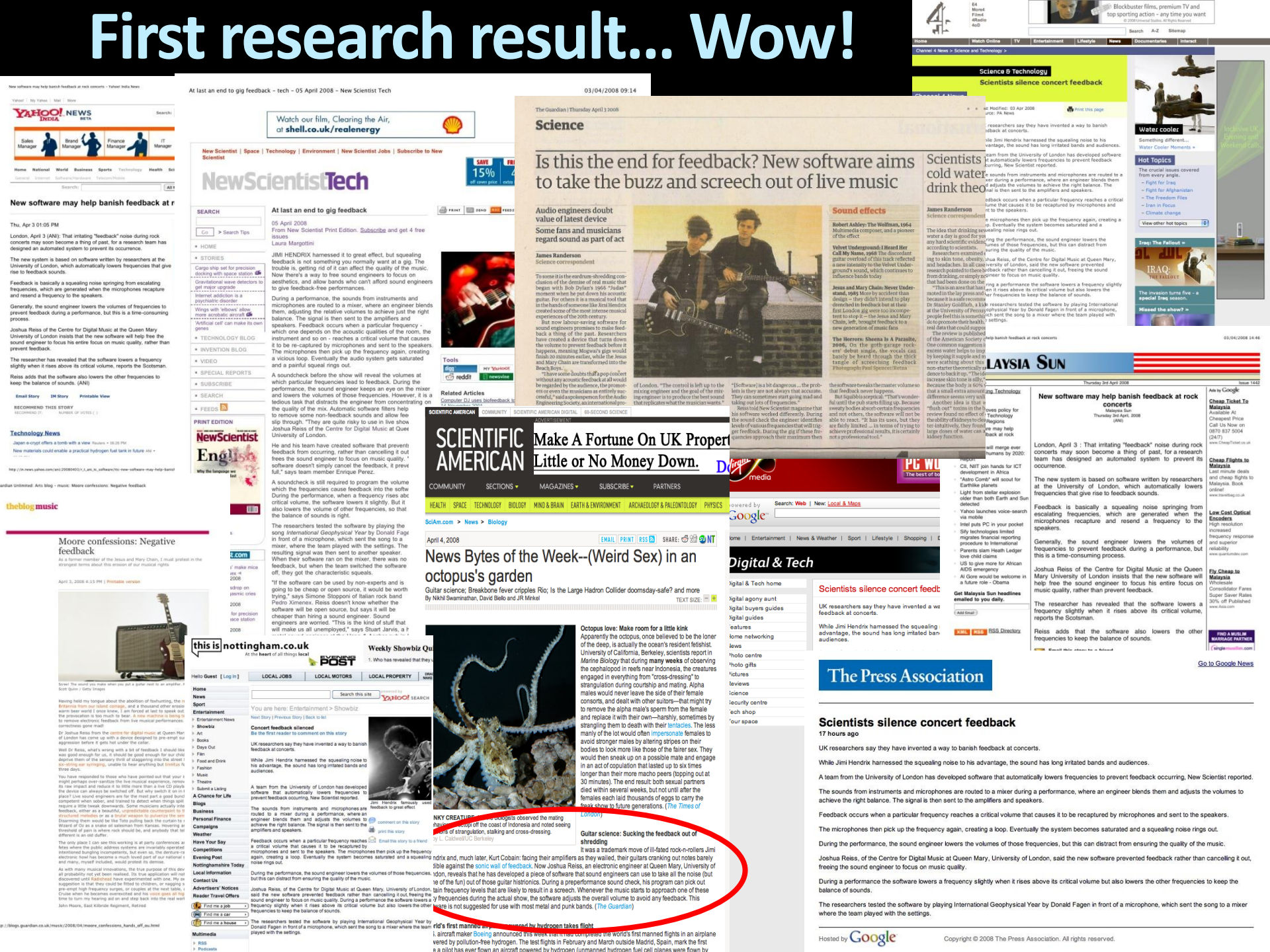
A case study from the Audio Engineering research group in the Centre for Digital Music

Josh Reiss, Sr. Lecturer
josh.reiss@eecs.qmul.ac.uk

It starts with a PhD proposal



First research result… Wow!



New software may help banish feedback at r

Thu, Apr 3 01:05 PM

London, April 3 (ANI): That irritating "feedback" noise during rock concerts may soon become a thing of past, for a research team has designed an automated system to prevent its occurrence.

The new system is based on software written by researchers at the University of London, which automatically lowers frequencies that give rise to feedback sounds.

Feedback is basically a squealing noise springing from escalating frequencies, which are generated when the microphones recapture and resend a frequency to the speakers.

Generally, the sound engineer lowers the volumes of frequencies to prevent feedback during a performance, but this is a time-consuming process.

Joshua Reiss of the Centre for Digital Music at the Queen Mary University of London insists that the new software will help free the sound engineer to focus his entire focus on music quality, rather than prevent feedback.

The researcher has revealed that the software lowers a frequency slightly when it rises above its critical volume, reports the Scotsman.

Reiss adds that the software also lowers the other frequencies to keep the balance of sounds. (ANI)

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At last an end to gig feedback

05 April 2008

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Laura Margottini

JIMI HENDRIX harnessed it to great effect, but squealing feedback is not something you normally want at a gig. The trouble is, getting rid of it can affect the quality of the music. Now there's a way to free sound engineers to focus on aesthetics, and allow bands who can't afford sound engineers to give feedback-free performances.

During a performance, the sounds from instruments and microphones are routed to a mixer, where an engineer blends them, adjusting the relative volumes to achieve just the right balance. The signal is then sent to the amplifiers and speakers. Feedback occurs when a particular frequency - which one depends on the acoustic qualities of the room, the instrument and so on - reaches a critical volume that causes it to be re-captured by microphones and sent to the speakers. The microphones then pick up the frequency again, creating a vicious loop. Eventually the audio system gets saturated and a painful squeal rings out.

A soundcheck before the show will reveal the volumes at which particular frequencies lead to feedback. During the performance, the sound engineer keeps an eye on the mixer and knows the volumes of those frequencies. However, it is a tedious task that distracts the engineer from concentrating on the quality of the mix. Automatic software filters help to remove occurring, rather than cancelling it out frees the sound engineer to focus on music quality. ' software doesn't simply cancel the feedback, it preve full," says team member Enrique Perez.

A soundcheck is still required to program the volume which the frequencies cause feedback into the softw During the performance, when a frequency rises abc critical volume, the software lowers it slightly. But it also lowers the volume of other frequencies, so that the balance of sounds is right.

The researchers tested the software by playing the song *International Geophysical Year* by Donald Fage in front of a microphone, which sent the song to a mixer, where the team played with the settings. The resulting signal was then sent to another speaker. When their software ran on the mixer, there was no feedback, but the team switched the software off, they got the characteristic squeals.

"If the software can be used by non-experts and is going to be cheap or open source, it would be worth trying," says Simone Stopponi of Italian rock band Pedro Ximenex. Reiss doesn't know whether the software will be open source, but says it will be cheaper than hiring a sound engineer. Sound engineers are worried. "This is the kind of stuff that will make us all unemployed," says Stuart Jarvis, a f

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Is this the end for feedback? New software aims to take the buzz and screech out of live music

Audio engineers doubt value of latest device

Some fans and musicians regard sound as part of act

James Randerson

Science correspondent

To some it is the eardrum-shredding conclusion of the demise of real music that began with Bob Dylan's 1966 "Judas" moment when he put down his acoustic guitar. For others it is a musical tool that in the hands of someone like Jimi Hendrix created some of the most intense musical experiences of the 20th century.

But now labour-saving software for sound engineers promises to make feedback a thing of the past. Researchers have created a device that turns down the volume to prevent feedback before it happens, meaning Mogwai's gigs would finish 20 minutes earlier, while the Jesus and Mary Chain are transformed into the Beach Boys. ...

"I have some doubts that a pop concert without any acoustic feedback at all would be regarded by the audience, the promoters or even the musicians as entirely successful," said spokesperson for the Audio Engineering Society, an international pro-

of London. "The control is left up to the mixing engineer and the goal of the mixing engineer is to produce the best sound that replicates what the musician wants."

"[Software] is a bit dangerous ... the problem is they are not always that accurate. They can sometimes start going mad and taking out lots of frequencies."

Reiss told New Scientist magazine that his software worked differently. During the sound check the engineer identifies levels of various frequencies that will trigger feedback. During the gig if these frequencies approach their maximum then the software tweaks the master volume so that feedback never happens.

But Squibbs is sceptical. "That's wonderful until the pub starts filling up. Because sweaty bodies absorb certain frequencies and not others, the software will not be able to react. "It has its uses, but they are fairly limited ... in terms of trying to achieve professional results, it is certainly not a professional tool."

Sound effects

Robert Ashley: The Wolfman, 1964 Multimedia composer, and a pioneer of the effect

Velvet Underground: I Heard Her Call My Name, 1968 The discordant guitar overload of this track reflected a new intensity to the Velvet Underground's sound, which continues to influence bands today

Jesus and Mary Chain: Never Understand, 1985 More by accident than design – they didn't intend to play drenched in feedback but at their first London gig were too incompetent to stop it – the Jesus and Mary Chain, left, brought feedback to a new generation of music fans

The Horrors: Sheena Is A Parasite, 2006. On the goth-garage rockers' debut single, the vocals can barely be heard through the thick tangle of screeching feedback

Photograph: Paul Spencer/Retna

Scientists cold water drink theo

James Randerson

Science correspondent

The idea that drinking se water a day is good for yo any hard scientific eviden according to scientists.

Researchers examined ing to skin tone, obesity and headaches. In all case research pointed to there from drinking, or simply dr that had been done on the

"This is an area that has noted in the lay press and because it is a safe recomm Dr Stanley Goldfarb, a k at the University of Penns people feel this is somethi do to promote their health real data that could suppo

The review is published of the American Society One common suggestion i excess water helps to imp keeping it supple and m were scathing about this non-starter theoretically b dence to back it up. "The id increase skin tone is silly because the body is 60% that a small extra amount difference seems very unl

Another idea is that w "flush out" toxins in the review found no effect of the ability of kidneys to cle ter-intuitively, they found large doses of water can kidney function.

Water cooler

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Scientists silence concert feedback

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April 4, 2008

News Bytes of the Week--(Weird Sex) in an octopus's garden

Guitar science; Breakbone fever cripples Rio; Is the Large Hadron Collider doomsday-safe? and more

By Nikhil Swaminathan, David Biello and JR Minkel

Octopus love: Make room for a little kink

Apparently the octopus, once believed to be the loner of the deep, is actually the ocean's resident fetishist. University of California, Berkeley, scientists report in *Marine Biology* that during **many weeks** of observing the cephalopod in reefs near Indonesia, the creatures engaged in everything from "cross-dressing" to strangulation during courtship and mating. Alpha males would never leave the side of their female consorts, and dealt with other suitors—that might try to remove the alpha male's sperm from the female and replace it with their own—harshly, sometimes by strangling them to death with their tentacles. The less manly of the lot would often impersonate females to avoid stronger males by altering stripes on their bodies to look more like those of the fairer sex. They would then sneak up on a possible mate and engage in an act of copulation that lasted up to six times longer than their more macho peers (topping out at 30 minutes). The end result: both sexual partners died within several weeks, but not until after the females each laid thousands of eggs to carry the freak show to future generations. (*The Times of London*)

Guitar science: Sucking the feedback out of shredding

It was a trademark move of ill-fated rock-n-rollers Jimi Hendrix and, much later, Kurt Cobain: facing their amplifiers as they wailed, their guitars cranking out notes barely audible against the sonic wall of feedback. Now Joshua Reiss, an electronic engineer at Queen Mary, University of London, reveals that he has developed a piece of software that sound engineers can use to take all the noise (but some of the fun) out of those guitar histrionics. During a preperformance sound check, his program can pick out certain frequency levels that are likely to result in a screech. Whenever the music starts to approach one of these frequencies during the actual show, the software adjusts the overall volume to avoid any feedback. This software is not suggested for use with most metal and punk bands. (*The Guardian*)

World's first manned flight powered by hydrogen takes flight

Aircraft maker Boeing announced this week that it has completed the world's first manned flights in an airplane powered by pollution-free hydrogen. The test flights in February and March outside Madrid, Spain, mark the first time a pilot has ever flown an aircraft powered by hydrogen (unmanned hydrogen fuel cell planes were flown by

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Concert feedback silenced

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UK researchers say they have invented a way to banish feedback at concerts.

While Jimi Hendrix harnessed the squealing noise to his advantage, the sound has long irritated bands and audiences.

A team from the University of London has developed software that automatically lowers frequencies to prevent feedback occurring, New Scientist reported.

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During the performance, the sound engineer lowers the volumes of those frequencies, but this can distract from ensuring the quality of the music.

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The researchers tested the software by playing International Geophysical Year by Donald Fagen in front of a microphone, which sent the song to a mixer where the team played with the settings.

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LAYSIA SUN

Thursday 3rd April 2008

Issue 1442

New software may help banish feedback at rock concerts

Malaysia Sun

Thursday 3rd April, 2008

(ANI)

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Reiss adds that the software also lowers the other frequencies to keep the balance of sounds.

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We're on to something...

Oct 2008

leader editor's comment

Automation For The People

Presets, whether for effects units, plug-ins or synths, come in for a stick, but for musicians who'd on with making music than getting into engineering, they can be ver There are lots of aspects of m automatic throu parallel with to begi

ideas as we get a lot of qu musicians as to how they can DAWs without having to keep brains back and forth from bei creative to dealing with the tec a degree of 'dumbed-down' au make the recording process ea it. After all, you could still swit auto-pilot and go back to man mixing, if you wanted to, beca the creative stuff should be do

Paul White *Editor In Chief*

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Musicians who'd rather get on with making music than get too deep into engineering

There's no reason why a band recording using reasonably conventional instrumentation shouldn't be EQ'd and balanced automatically by advanced DAW software.

We start building a team…

Fully Integrated, Intelligent Mixing Systems for Live Musical Performance

Michael Terrell

April 17, 2009

Abstract

An intelligent mixing system, which integrates both stage sound and front of house sound, and th
interconnectivity between them is developed. A mathematical model of the stage sound is derived whicl
describes the perceived loudness of each instrument to each musician. Practical limitations on the stag
sound are enforced, for example maximum monitor level before feedback, and maximum and minimun
loudness for each performer. The desired mix of each listener can then be input to the model, and th
monitor mix settings which best satisfy all requirements can be found.

The interconnectivity between the stage sound and front of house sound is investigated, enabling th
contribution of the stage sound to the front sound to be incorporated into established automatic mixin
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MSc Project Report

Investigation in

Dynamic Range Compression

Name: Michael Massberg

Student No.: 089606027

Supervisor: Dr. J.D. Reiss

Date: 25 August 2009

1

A high quality sub-band approach to musical transient modification

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Affiliation3
author3@smcnetwork.org

ABSTRACT

This paper presents a sub-band transient detection and mod-
ification algorithm suitable for changing the level of tran-
sient parts with re
nals. The detectio
Time-Fourier-Tran
implementation is
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methods in detail. Although the effect is commonly used on a single percussive instruments it is also intended to spot the ability to identify transient parts of instruments with soft onsets detect transient parts in complex mixes.

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parts of tones.

1.1 Motivation

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Research Proposal - Hardware Development of Intelligent Audio Consoles (IAC) --- DRAFT v0.2

Research Student: Yonghao Wang
Supervisors: Joshua Reiss (First)

1. Abstract

The aim of this research is to develop a system framework for intelligent audio consoles (IAC). The architectural design of the proposed hardware framework should have the capability, scalability and usability for high resolution and multi-channel intelligent audio processing as well as providing a novel user experience for audio /sound engineers.

2. Background

Modern recording studios are normally equipped with digital audio workstations (DAWs), which are high performance computers with audio processing software. However, the audio console hardware is still the essential device of audio production in many situations. The operability of an audio console is irreplaceable even with the availability of software virtual consoles [1].

Like many other engineering areas, the audio console has mostly moved from the analogue to digital domain. The earlier types of digital console were mimics of their analogue counterparts. With the development of high speed digital signal processors and microprocessor technology, modern digital audio consoles continuously add new features and expand their territory[a].

Researchers at the Centre for Digital Music at Queen Mary University have proposed a set of novel algorithms to automate some engineering processes during various stages of recording, down-mixing, and playback [4][5]. The characteristics of the proposed algorithms are often multiple-channel dependent and involve computation both in time and frequency domain, using advanced signal process techniques, as well as optimisation, control theory, and artificial intelligence.

In order to integrate those algorithms into a digital audio console, the proposed IAC hardware architecture should have the capacity to deal with high-resolution multiple channel inputs. A modular design will be considered, in order to address the requirements of flexibility and scalability. The system is considered to be divided into control plane and data plane, in which the control plane shall calculate the control parameters based on the algorithms, and the data plane shall process the high speed real time audio stream using the parameters updated by control plane. This design is borrowed from network processor architecture design for data communication applications due to the fact of similar natural of the tasks [2].

A multi-core processor system will be proposed, which comprises a general purpose microprocessor core as control panel, and one or multiple DSP cores as the data

[a] Author: It seems most digital audio console manufacturers make most efforts to refine the modelling or emulation of analogue devices for recovering subtle detail of analogues devices.

1

Automatic Target Mixing

Daniele Barchiesi

February 4, 2009

General framework

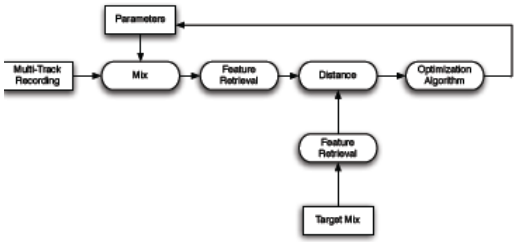

Figure 1: General Framework

utomatic target mix is obtained from the multi-track recording applying a set of parameters which ize the distance between the feature extracted from the mix and the feature extracted from the target

Solving the optimization problem. A geometric approach

ssume that the parameters of the mix are the gains applied to each track and that we are comparing r feature extracted from mix and target, such that:

$$F(\alpha_1 v_1 + \alpha_2 v_2) = \alpha_1 F(v_1) + \alpha_2 F(v_2) \qquad \forall \alpha \in \mathbb{R}$$

he optimization task can be solved analytically using least squares.

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First proof of concept

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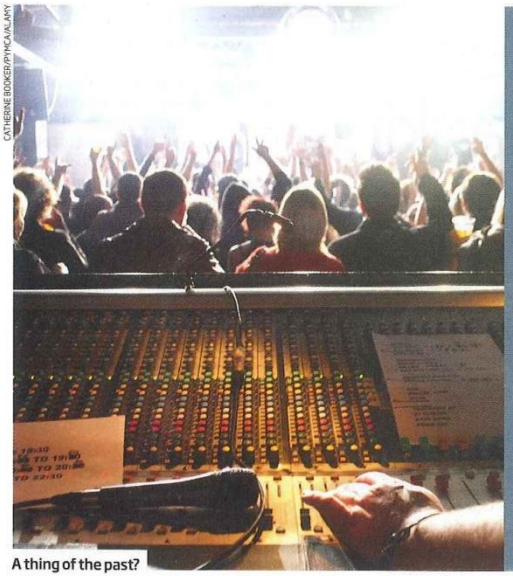

CATHERINE BOOKER/PYMCA/ALAMY

A thing of the past?

Enter the robot sound desk

MUSICIANS will soon be able to deliver a slick live performance without employing an acoustic engineer – and audiences won't know the difference.

"A lot of what sound engineers do is rule-based," says Enrique Perez Gonzalez, an electronic engineer at Queen Mary University of London's Centre for Digital Music. So he and Josh Reiss, also at the CDM, have created a piece of software, called Automatic Mixing, to take care of basic sound engineering functions such as mixing and switching channels.

The software ensures sounds don't distort by using an automatic gain tool to adjust signal levels from different instruments or microphones. It can also boost the bass or treble from an instrument or vocal track by increasing the strength of signals from specific frequency bands.

Sounds from an instrument can cancel each other out if they are picked up by more than one microphone, so the software inverts the signals from offending sound sources to stop this happening. Other features include introducing slight delays to align the instruments' signals, spreading the sound signals to generate a stereo effect and an anti-feedback function.

"The software should allow sound engineers to concentrate on more creative tasks"

However, the software is not intended to replace sound engineers. Instead, it should allow them to concentrate on more creative tasks, says Reiss. It will be launched at the Audio Engineering Society Convention in London in May.

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our home territory in London
year, we wanted to do some-
g a bit special."

The APx525 audio analyser will make its European debut

Audio Precision debuts APx family additions

Audio Precision is using the AES Convention in London as the platform to show its recently released ultra-high bandwidth analyser option for the APx525 family of audio analysers for the first time in Europe.

The BW52 High Bandwidth option extends the APx's FFT (Fast Fourier Transform) capability all the way to 1MHz, with 24-bit resolution and 2.38Hz bin width, making APx suitable for looking at out-of-band noise in Class D amplifiers, sigma-delta converters and other modern audio devices.

"Compared to the previous state of the art, an FFT of this length and resolution is like trading a pair of reading glasses for the Hubble telescope," says Bruce Hofer, chairman and co-founder of Audio Precision. "It's a real technical achievement for the company."

Automation mixing and more from Queen Mary's C4DM

The Centre for Digital Music (C4DM), a multidisciplinary research group in the field of Music & Audio Technology at Queen Mary, University of London that works with industry leaders in forging new business models for the music industry, will be showing the latest technologies at its interactive stand at AES.

Featured technology includes The Automatic Mixing Tools, which can generate an automatic sound mix out of an unknown set of multichannel inputs. This one-of-a-kind technology can work with either live sound or post production.

Software programme B-Keeper changes the tempo of a sequencer (current demo in Ableton Live) so that it synchronises with a drummer. This means that loops and pre-recorded parts will stay in time without forcing the drummer to play to a click track.

Also on show is Audio Browser, which creates a virtual environment to help users to navigate easily around an audio library.

The C4DM research group will be showing the latest innovations

Finally, The Rhythm Transformation Software can be used to mix together two pieces of music so that they are synchronised not only at the level of musical beats but also in terms of finer rhythmic structure.

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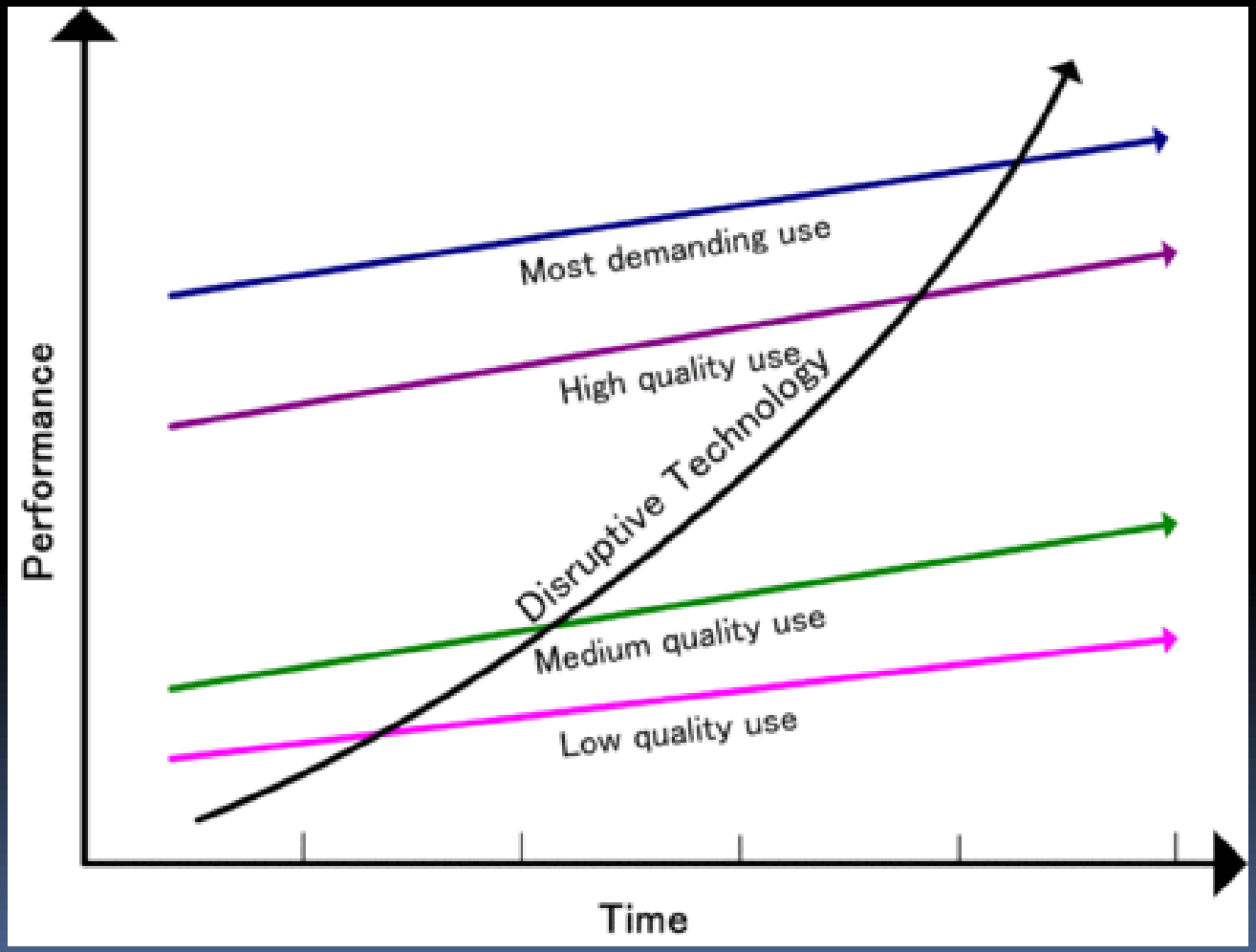


The elevator pitch

- The modern digital camera
  - Auto-focus
  - Red-eye removal
  - Image stabilizer
  - Face,
  - Scene detection
  - Motion detection
  - …
- The modern digital audio console
  - No intelligent features
  - Requires a professional
  - Quality suffers

An auto-focus for audio!

and so much more…

Companies interested…

- “We were reading the article in New Scientist about your projects on Automixing and are interested in learning a little more, or even seeing if there’s a way we may be able to find some commercial applications” – Director of New Products at one of the world’s biggest mixing console manufacturers

But…

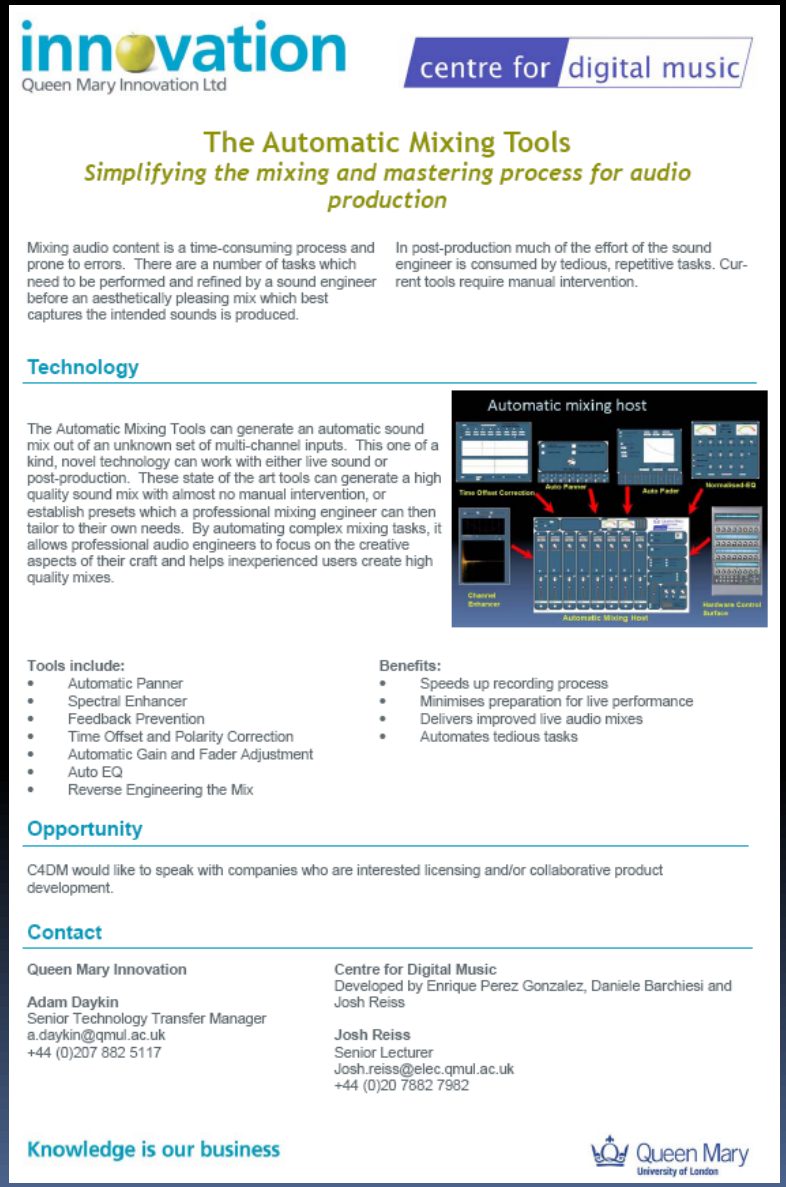
- Enrique graduates… ☺ and ☹
  - Now Product Manager at Solid State Logic

Solid State Logic
SOUND || VISION

- Project students move on.
- Company interest heats up
- Queen Mary Innovation supports the R&D
- I get a grant to commercialise research

ROYAL ACADEMY OF ENGINEERING

- Enter Stuart, Alice, Sina, Zheng…



innovation
Queen Mary Innovation Ltd

centre for digital music

The Automatic Mixing Tools

Simplifying the mixing and mastering process for audio production

Mixing audio content is a time-consuming process and prone to errors. There are a number of tasks which need to be performed and refined by a sound engineer before an aesthetically pleasing mix which best captures the intended sounds is produced.

In post-production much of the effort of the sound engineer is consumed by tedious, repetitive tasks. Current tools require manual intervention.

Technology

The Automatic Mixing Tools can generate an automatic sound mix out of an unknown set of multi-channel inputs. This one of a kind, novel technology can work with either live sound or post-production. These state of the art tools can generate a high quality sound mix with almost no manual intervention, or establish presets which a professional mixing engineer can then tailor to their own needs. By automating complex mixing tasks, it allows professional audio engineers to focus on the creative aspects of their craft and helps inexperienced users create high quality mixes.

Tools include:
- Automatic Panner
- Spectral Enhancer
- Feedback Prevention
- Time Offset and Polarity Correction
- Automatic Gain and Fader Adjustment
- Auto EQ
- Reverse Engineering the Mix

Benefits:
- Speeds up recording process
- Minimises preparation for live performance
- Delivers improved live audio mixes
- Automates tedious tasks

Opportunity

C4DM would like to speak with companies who are interested licensing and/or collaborative product development.

Contact

Queen Mary Innovation

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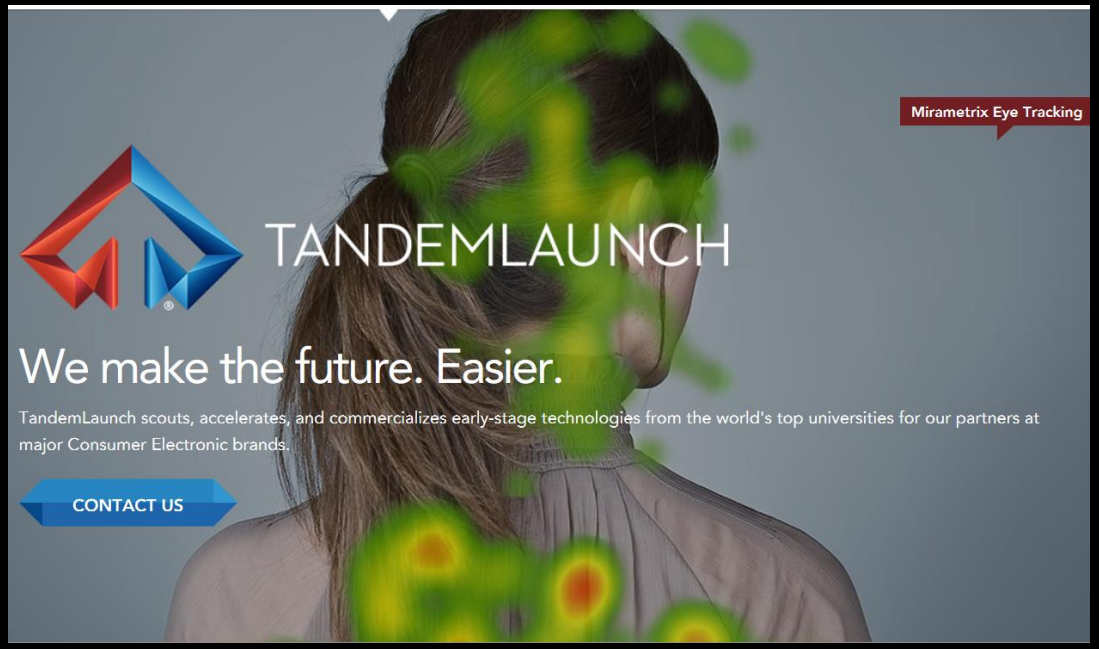
Knowledge is our business

Queen Mary University of London

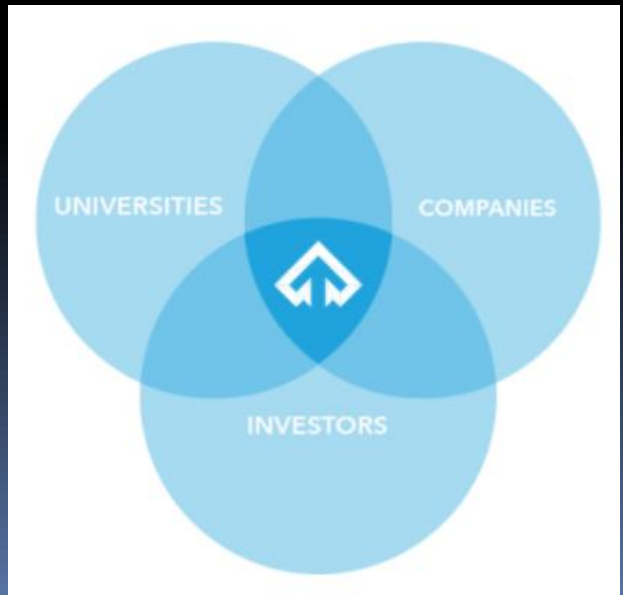
FOUNDING THE COMPANY & INVESTMENT

Enter Tandem Launch Technologies

- Venture Fund

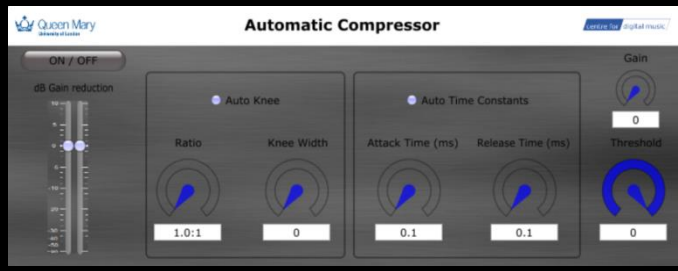


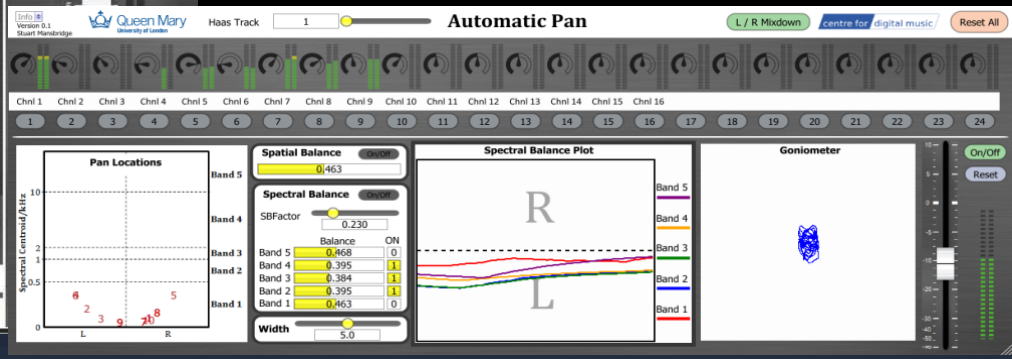
- Unique business model

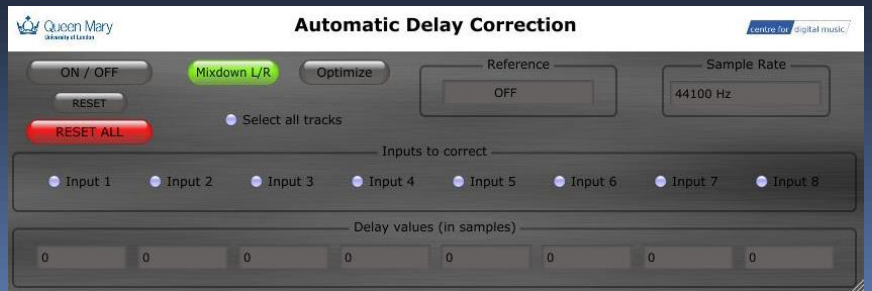


Proof of concept → Prototype

- We build new demonstrators
- C++ code, VST plugins, videos, patents …
- Much closer to 'Industry Ready'



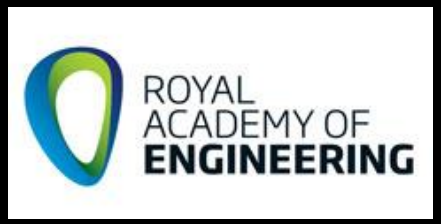




Proof of concept → Prototype + Continual Conversation = Investment!

- $400K investment from Tandem Launch ☺
- "We have a slight hiccup"

versus



- Solution: Two start-up companies
  - Automatic Music Production Systems Ltd. (UK company)
  - 8352593 Canada Inc. (Canadian company)
- Second stage investment →

The challenge, the contradictions

Academia

- High risk research with unknown outcomes
- Want new ideas & knowledge
- Ends with proof of concept
- Share the knowledge
  - Publish
- Spend the money

Industry

- Real world problems with assured solutions
- Want market validation
- Starts with prototype
- Protect the IP
  - Patent
- Generate revenue

Lessons and dilemmas

Dilemma

- Do I start a company?
- Who are the cofounders?
- Cofounder positions?
- Who makes the decisions?
- How to divide equity?
- Who and how to hire?
- Who to invest and how to raise capital?
- Founder vs CEO

Approach

- Yes! Sort of…
- University, student, incubator
- Nail this down but leave space to adapt
- Be explicit!
- Rational, fair. Balance the rewards.
- Put in the effort!
- Need options, don’t give away too much too soon.
- Expect a battle.

An alternative route to commercialisation

- Dissemination generates interest
- Assets are the team, the knowledge
- Value is in the research
- Unique selling point is in the research breakthrough
  - Protect? Ok.
  - Publicise? Yes!

- No single route to commercialisation
- Enjoy the journey!

Thanks!

And thanks to Enrique Perez Gonzalez, Stuart Mansbridge, Alice Clifford, Sina Hafezi, Zheng Ma, Brecht De Man, Dimitrios Giannoulis, Michael Massberg, Jacob Maddams…

Questions?

- Company website(s)
  - mixgeni.us , mixgenius.com , mixgenius.co.uk …
- Research website
  - c4dm.eecs.qmul.ac.uk/audioengineering.html
- Youtube channel
  - www.youtube.com/user/IntelligentSoundEng
- Publications
  - www.eecs.qmul.ac.uk/~josh/publications.htm