

FLEXOUND™

AUGMENTED AUDIO

Flexound Augmented Audio introduction

– vibration based nearfield listening approach basics and demonstrations

Jukka Linjama, CTO, Flexound Systems

Aalto Acoustics and audio technology seminar 25.3.2019

Take-on message

*Flexound Augmented Audio is
a new multi-sensory approach to listening.*

Call for fundamental and applied research!



About the Messenger – Jukka Linjama



*Roots in research :: Body in UX
:: Leaves in entrepreneurship ::*

Senseg



NOKIA



FLEXOUND™
AUGMENTED AUDIO

- Dr Jukka Linjama, Aalto alumni
 - CTO @ Flexound Systems – the Augmented Audio Company, 2015 -
 - Startup Entrepreneur: Senseg, RESONOIVA Design
 - Research and R&D: VTT, Nokia Mobile Phones
 - MSc 1985, DrTech 1994, HUT acoustics & electronics engineering
 - vibration energy flow measurements, psychoacoustics, haptics, UX design

Contents



- Flexound Augmented Audio
- Principle
 - Elastic vibration element EVE
 - User experience
- Demo: Humu cushion, cinema seat backrest
- Discussion
 - Why it works?
 - Call for fundamental and applied research

Sense of touch and hearing



- Sense of touch gives us the body awareness. It is the most fundamental of our senses – it is needed for all motor activities to be successful
- Our senses work automatically together; sense of touch and vibration supports hearing ¹
- Low frequency sounds (20 – 500 Hertz) are perceived also as vibration on skin and body, in addition to hearing with ears.
- Very low frequency sounds need to be loud to be heard, and they create vibration that resonates in the whole human body

1. Pulkki & Karjalainen, Psychoacoustics, Wiley 2015

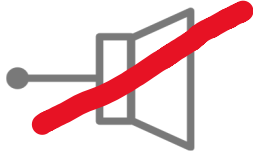
Flexound Augmented Audio – solution principle



- Sound is mechanical vibration of medium (air, water, solid material). We can perceive sound vibrations both by ears and by the sense of touch.
- Conventional sound and vibration technologies use separate solutions for these two senses.
 - A conventional **loudspeaker** radiates sound to surrounding air. Our ears sense airborne sound vibrations
 - A mechanical **vibration shaker** generates low frequency effects that rumble structures, for example a game seat. Our skin senses structure-borne vibrations
- **Flexound** Augmented Audio technology provides a new dimension to listening by combining both sound and low frequency effects
 - Solutions like this create a personal nearfield sound atmosphere

Flexound Augmented Audio driver

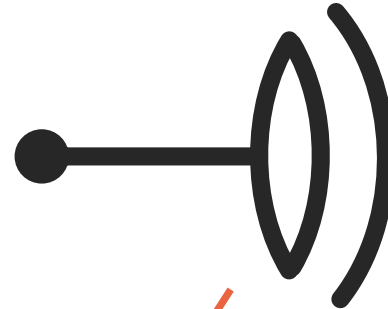
No Loudspeaker



No Headphones

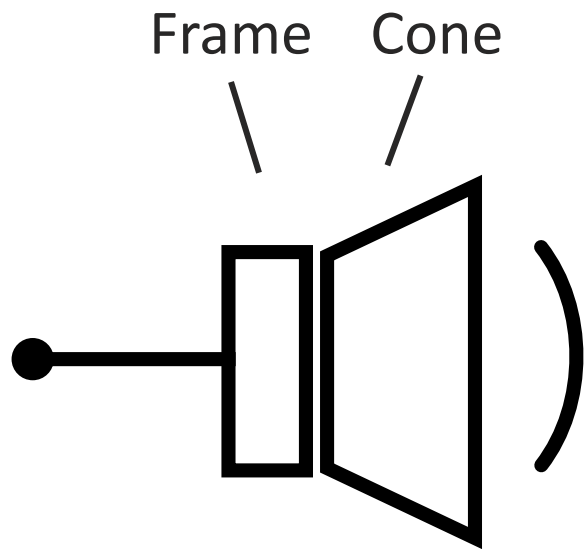


FLEXOUND™
AUGMENTED AUDIO

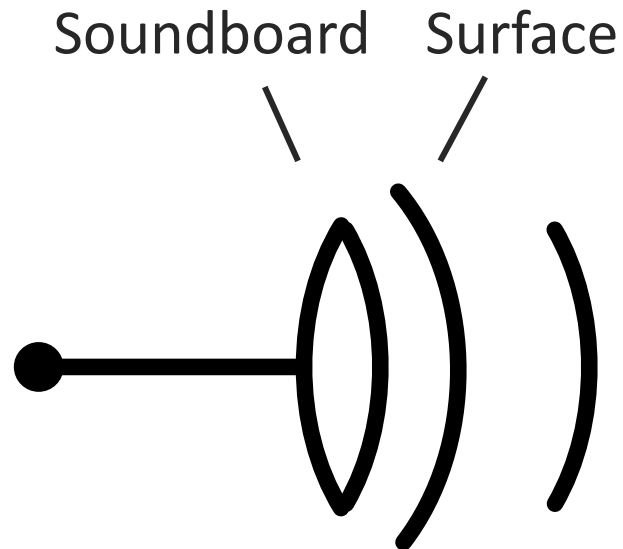


Sound board

Soft Surface



Loudspeaker
Element



Augmented Audio
Element

Example – Flexound enabled product Taikofon

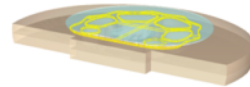
End Product



Soft Adapter Components



Elastic Vibrating Element™

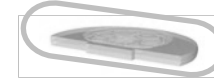


Electronics



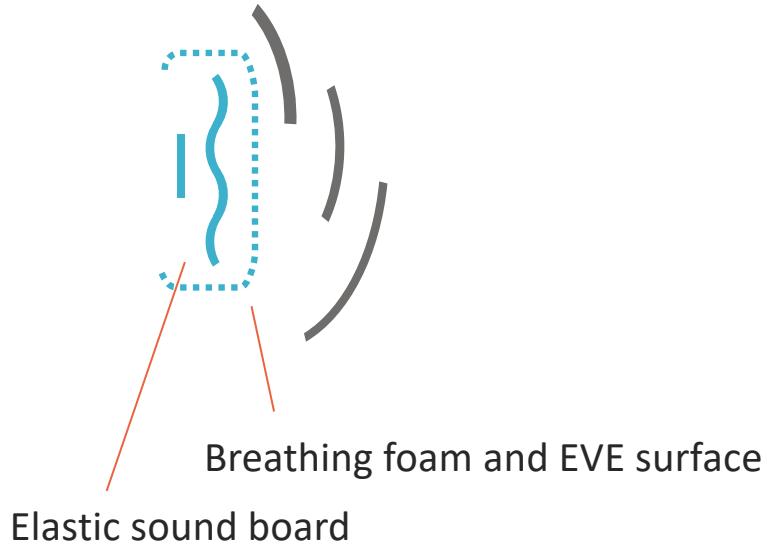
Unlike loudspeakers that are too loud when listened in ear contact, we use dedicated Elastic Vibrating Elements that transmit both structure-borne and airborne sound to the product surface.

Pillow speaker vs. Flexound Augmented Audio Cushion

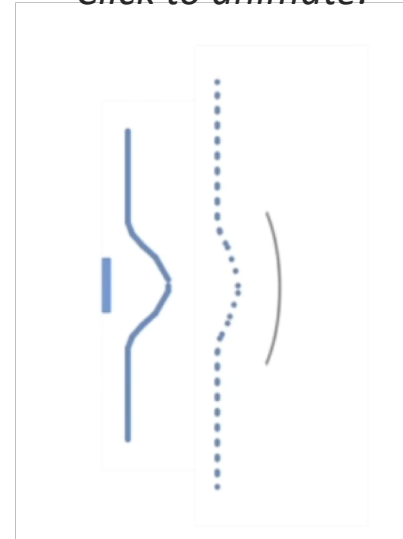


Product Feature	Sound Pillow speaker	FLEXOUND AUGMENTED AUDIO
Soft device, relaxing listening experience in contact with cushion	ok	ok
Personal, silent listening without headphones	ok	ok
Feel sound waves: enhance emotions	-	ok
Strong bass kick with a low listening volume	-	ok
Acoustic space illusion, surround “sound aura” soundscape	-	ok
Sound clarity, enhanced by skin contact to sound waves	-	ok

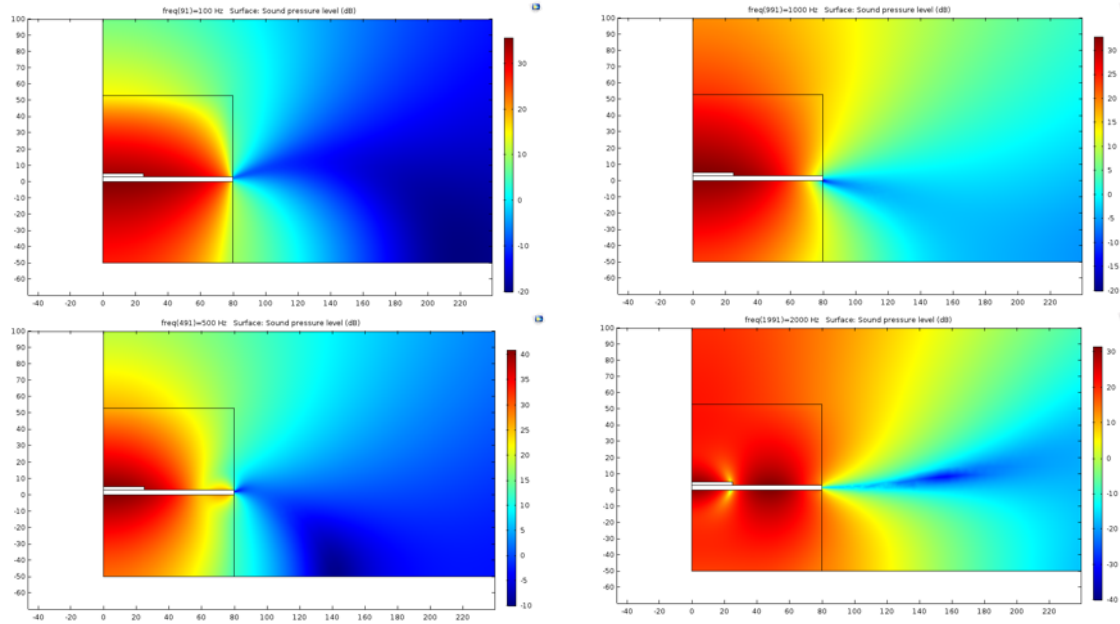
Animation of EVE vibration and sound radiation



Click to animate:



Vibroacoustic behaviour modelling of poroelastic plate dipole



Linjama et al, Akustiikkapäivät 2017

Poroelastic foam properties are challenging to model and simulate

Kuva 5. Herätelevyn tuottama äänenpainetasojakauma lähikentässä, kun absorbentin akustinen toiminta otetaan huomioon, taajuudet 100, 500, 1000 ja 2000 Hz.

Flexound

User experience A B C

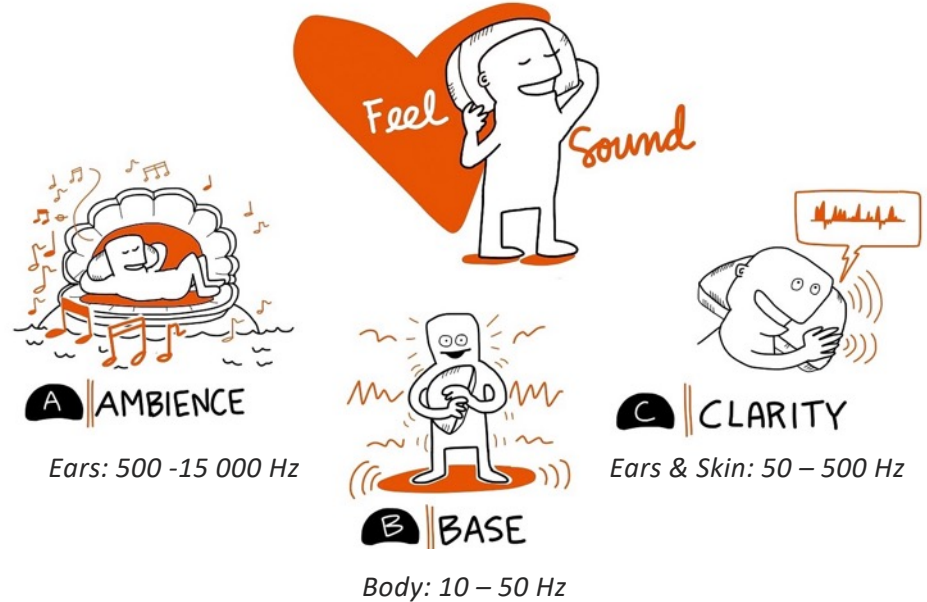
A – Ambience for your ears

B – Base for your body

C – Clarity for your ears 'n skin

FLEXOUND
XPERIENCE

A B C

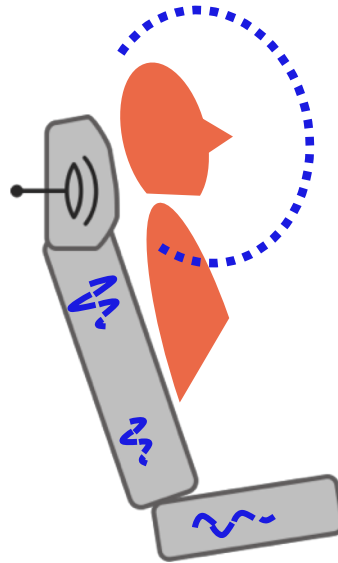


Flexound Augmented Audio User experience

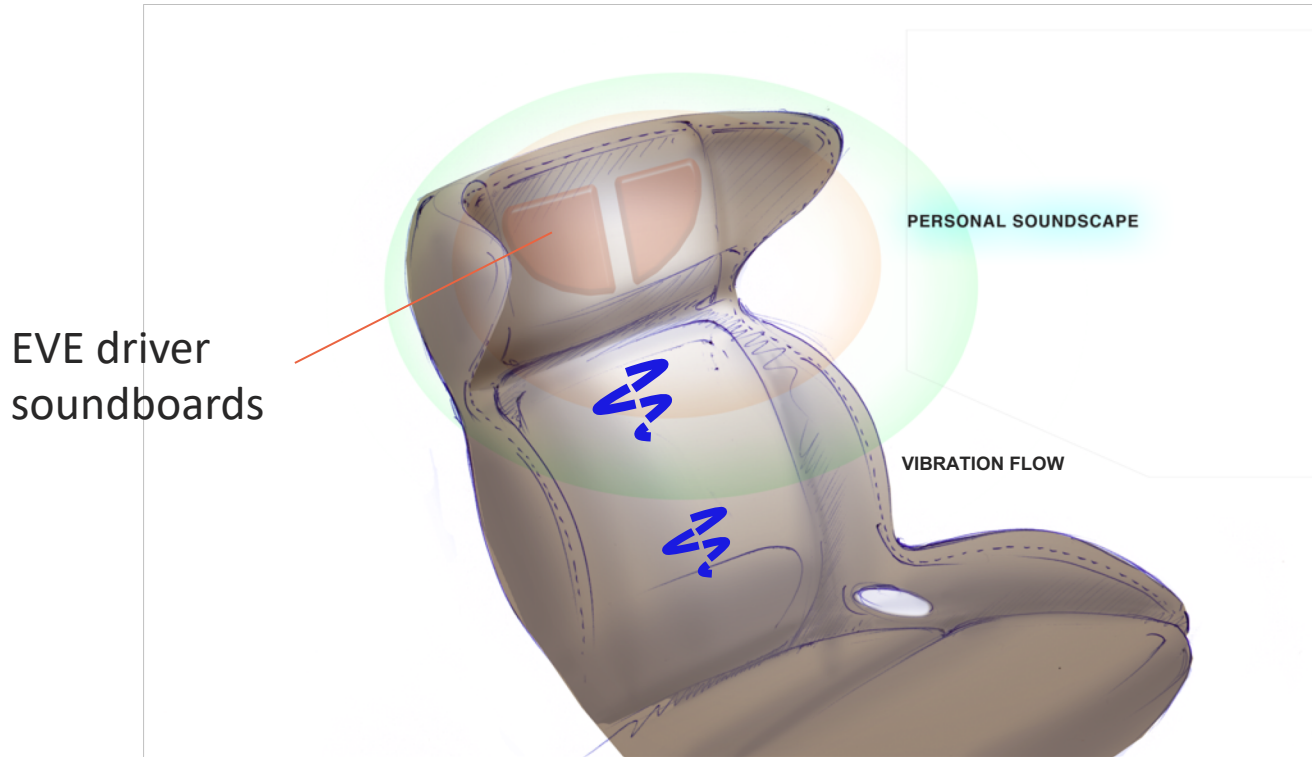
*Accurate
personal soundscape*

+

*Immersive
feel of soundwaves*



FLEXOUND Personal soundscape + soundwave feel



EVE driver
soundboards

PERSONAL SOUNDSCAPE

VIBRATION FLOW

Demonstrations – enjoy!

- Humu Augmented Audio cushion
- Seat backrest



Why it works?



- Soundwave vibration and personal ambient soundscape create a strong feel of immersion
- Music as such is very emotional -- but why?
- Sense of touch is very intimate, proximate – brings sense of presence?

Speculative hypothesis: Holistic experience of Soundscape and Feelscape

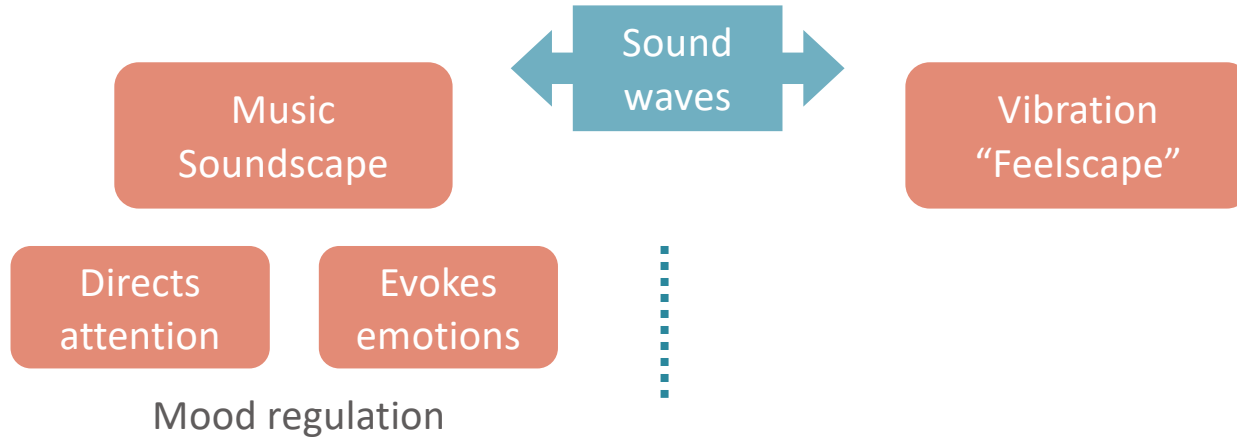
Music moves you

- Perhaps the greatest gift of music lies in its capacity to allow people to **experience emotions** without the burden of having to experience the life events that lead to them. We can experience even extreme emotions in a controlled manner, at will, in comfortable circumstances.¹
- Music listening affects our mood based as it unconsciously directs attention and evokes memories that are associated with it: based on music type it can either relax or energize ²
- Therapy use: music therapy
- Everyday use: help concentrate, relax, energize, seek mood

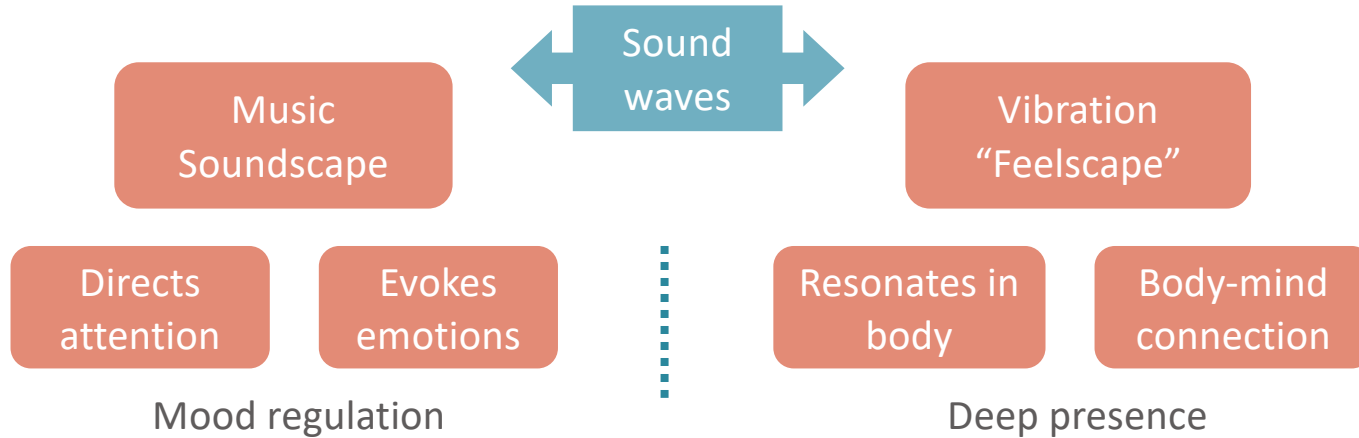


1. <http://syncproject.co/blog/2015/7/21/music-and-emotion>
2. Tunne aivosi, Minna Huotilainen & Leeni Peltonen. Otava 2017

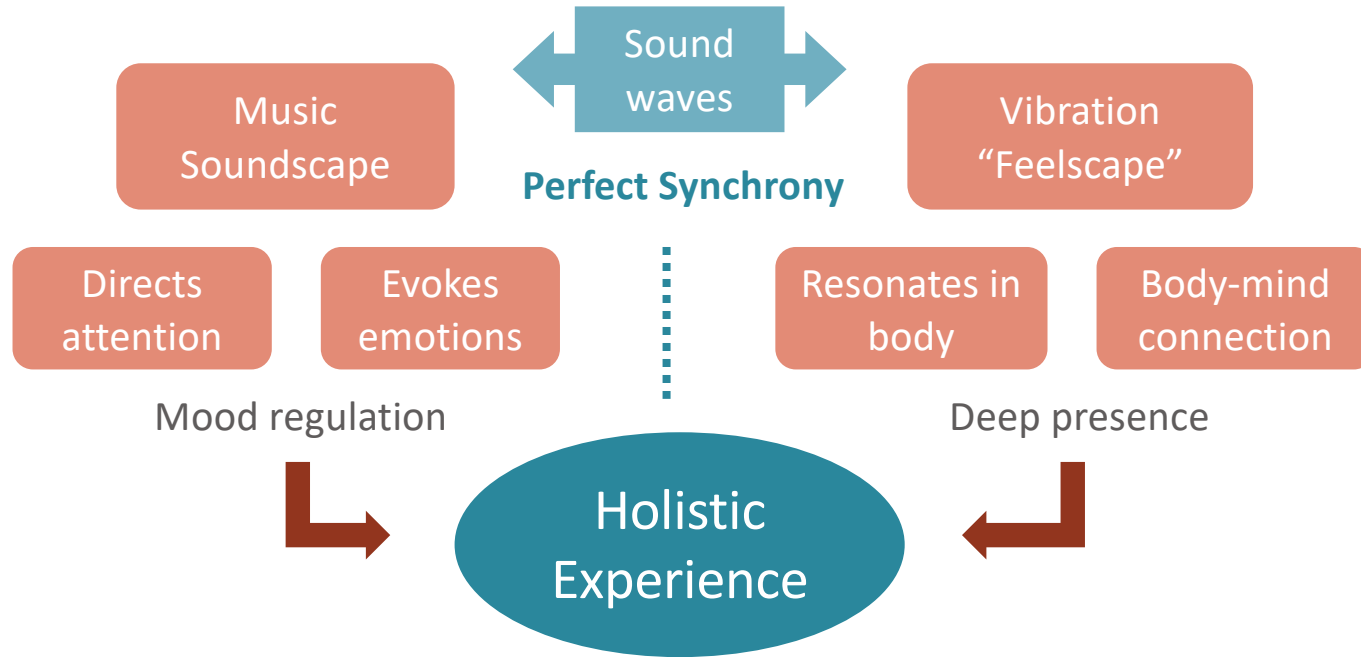
Flexound Augmented audio elements – a) soundscape



Flexound Augmented audio elements – b) “feelscape”



Flexound Augmented audio – why it works?



Call for action!



- Expand acoustics to augmented audio – New multi-sensory listening paradigm
 - 1) Audio-tactile perception > audio + tactile
 - 2) Nearfield directivity & spatial hearing
 - 3) Vibroacoustic modelling
- Identify relation to headphone listening
 - Equalisation, binaural processing, ...
- Visit Kino Mäntyharju to experience & study
 - great movies, first commercial Flexound augmented audio!

FLEXOUND™

THE AUGMENTED AUDIO COMPANY