
Sorama
visualising sound and vibrations

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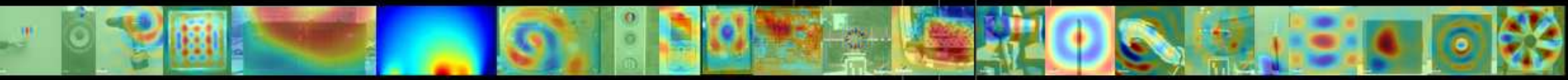
Sound Camera



A Holografic Perspective

Dr. Rick Scholte

TANGO Outreach - Munich 30 January 2014

Sound Imaging, why?

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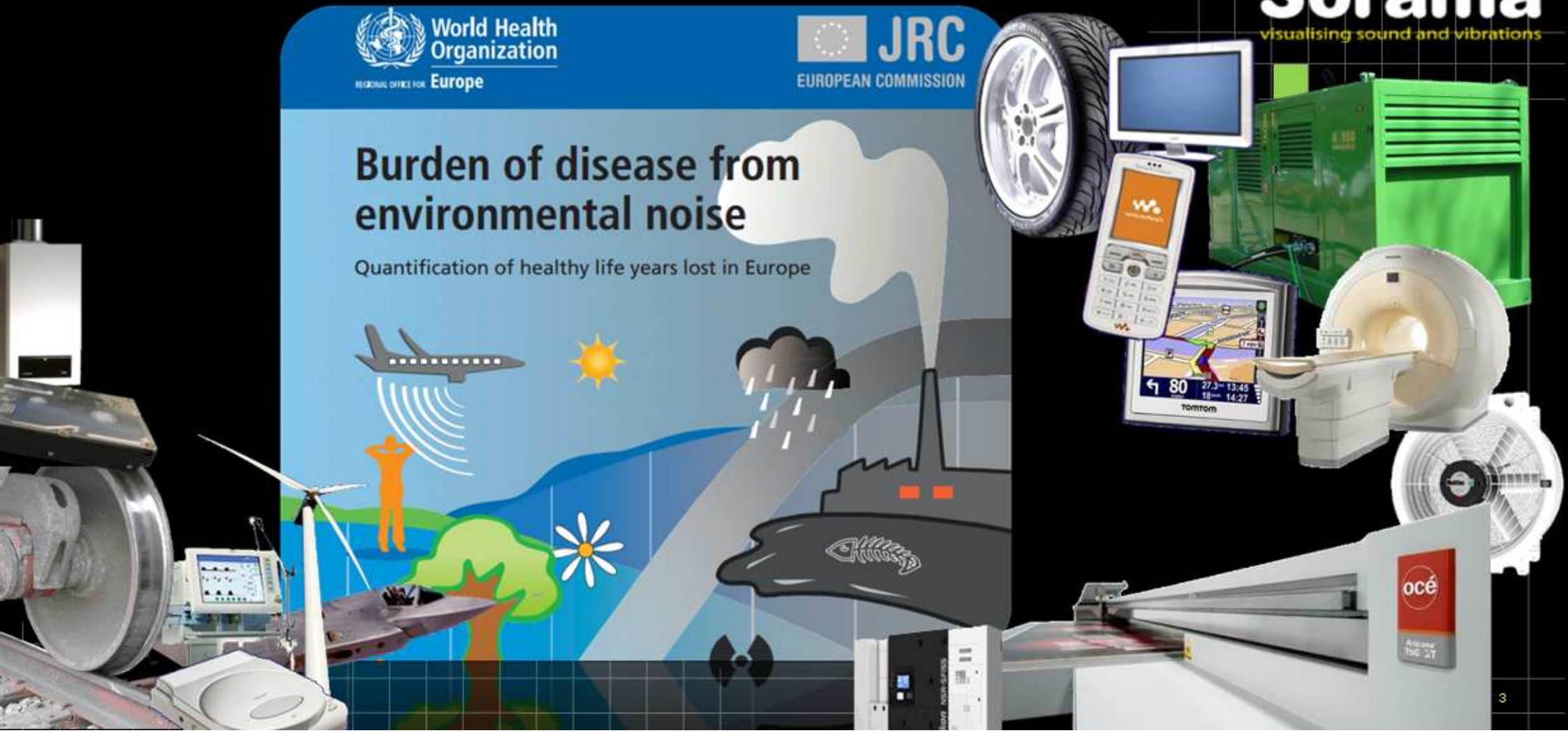

Case: ICE hydraulic generator
ICE Power Pack RF550
diesel engine & hydraulic pumps

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Problem:

Generator does not comply to new EU noise emission standards

Goal:

- Lower total noise level
  - ✓ Localize major sources
  - ✓ Visualize source behavior
  - ➢ Take reduction measures ?

Case: ICE hydraulic generator
ICE Power Pack RF550

source identification: engine exhaust on roof

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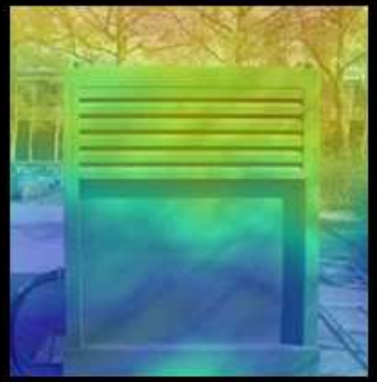
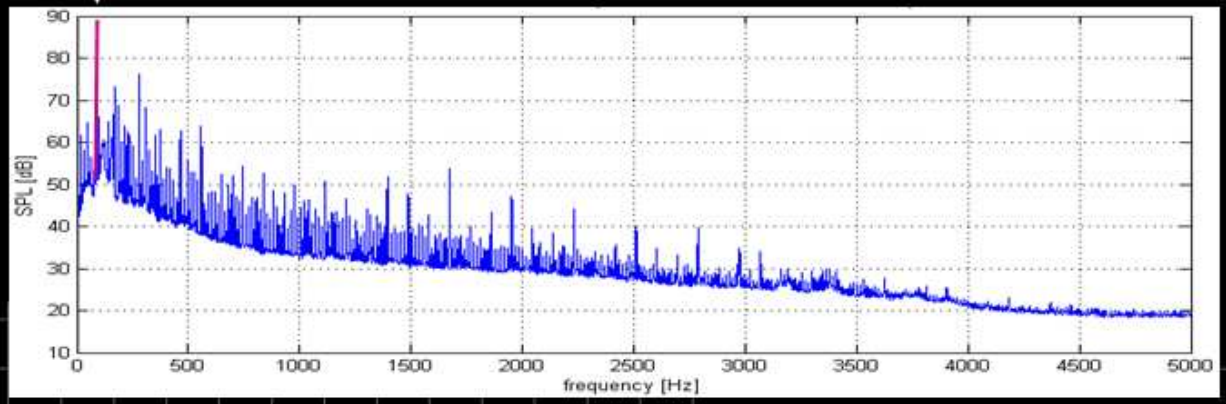


f=93Hz (3x1860/60)



Case: ICE hydraulic generator
ICE Power Pack RF550

source identification: ventilation brackets

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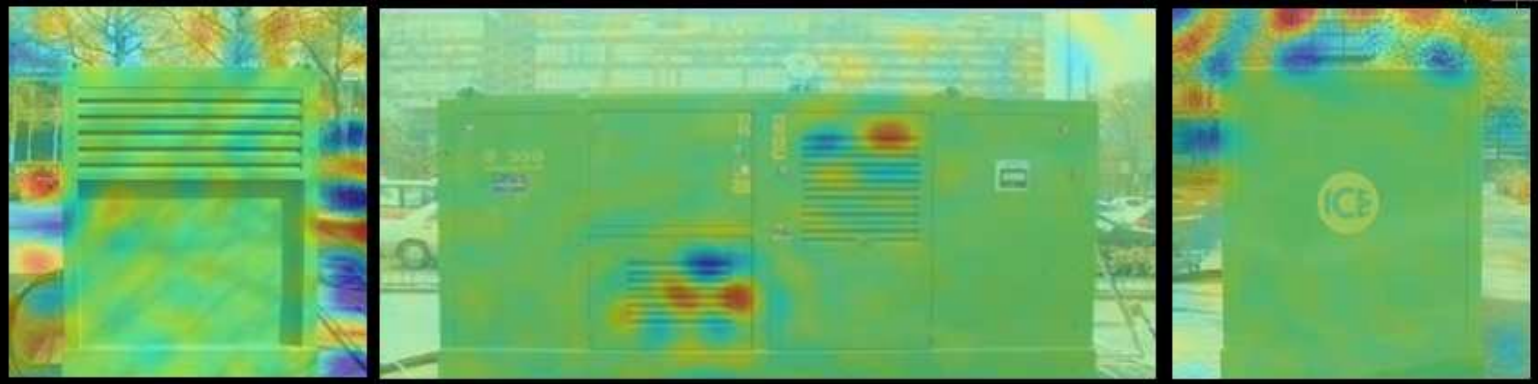
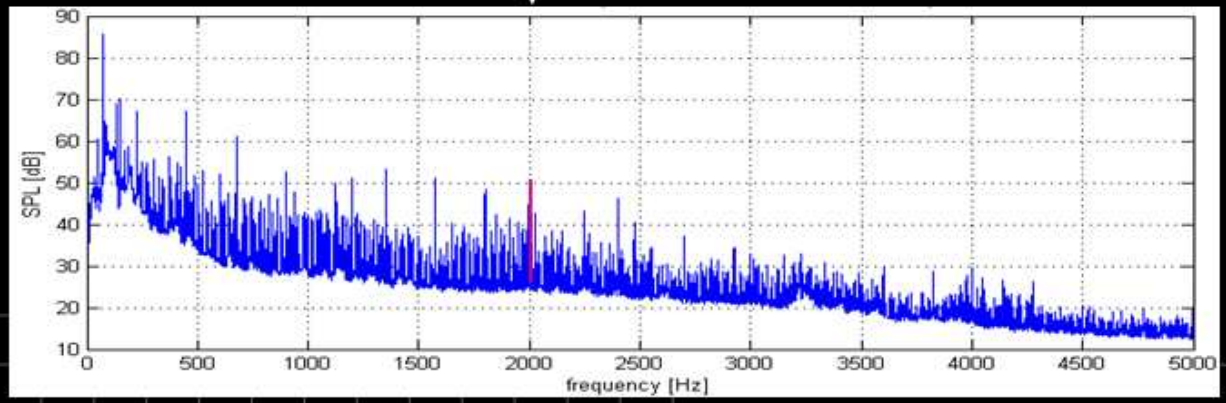


f=2000Hz



Sound Imaging Source Analysis

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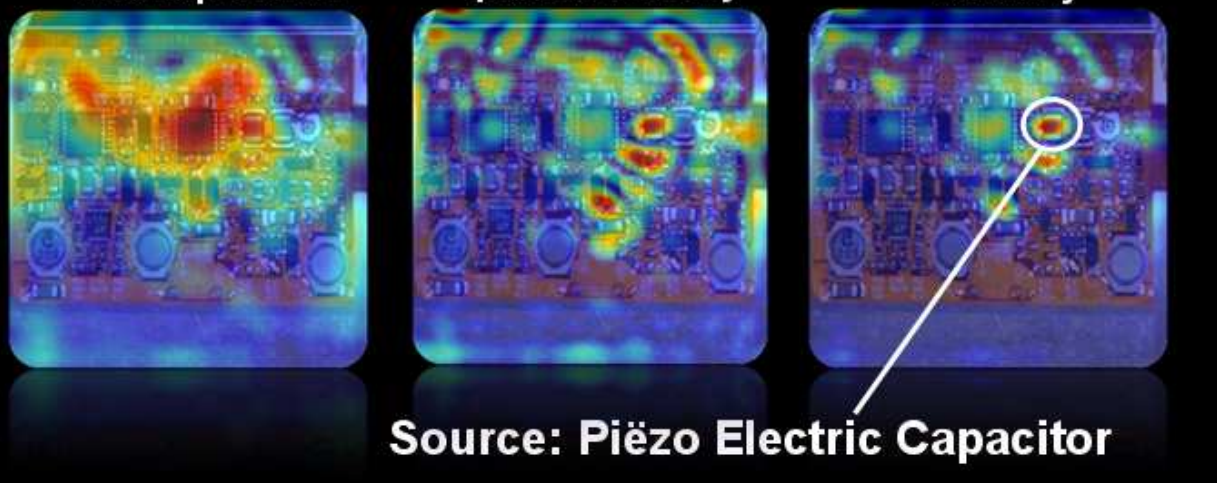
Problem:

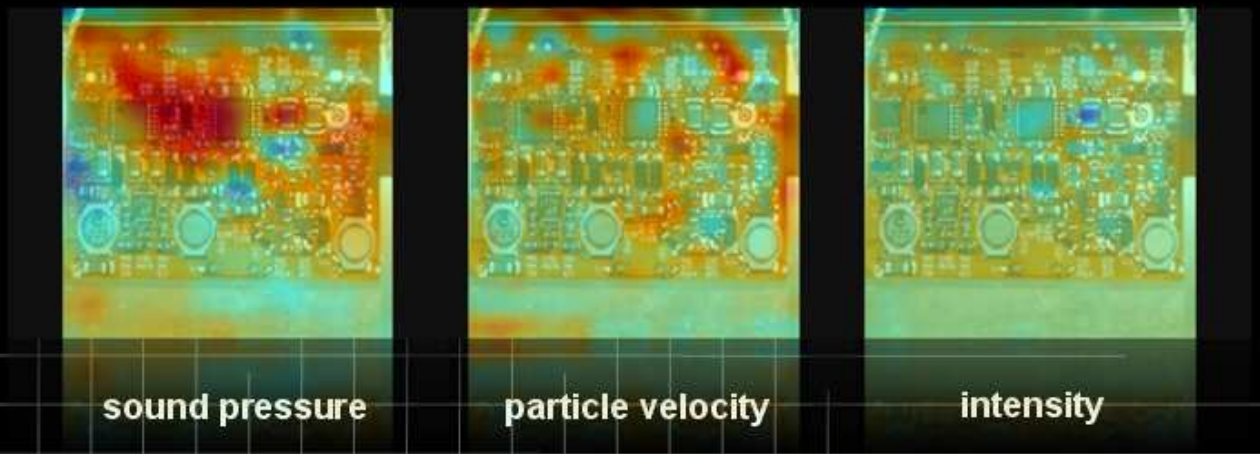
Generator does not comply to new EU noise emission standards

Goal:

- Lower total noise level
  - ✓ Localize major sources
  - ✓ Visualize source behavior
  - ➢ Take reduction measures
    - ➢ Exhaust damper
    - ➢ Fixate ventilation rosters
    - ➢ Less absorption material required → more effectively placed

Case: Mini-SMD Printed Circuit Board





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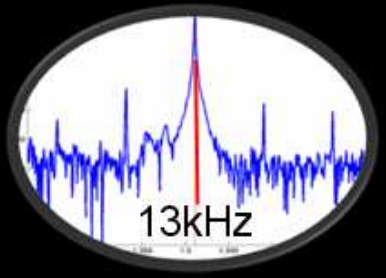
Resolution < 2mm
Aperture 4 x 4 cm
32 x 32 positions



(Source: Philips Applied Technologies)

Acoustic Waves

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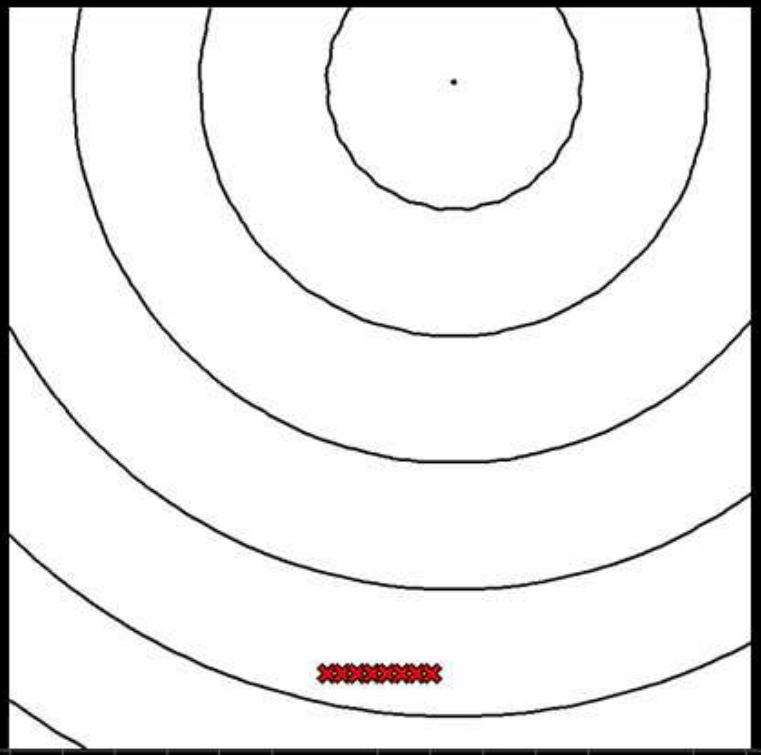
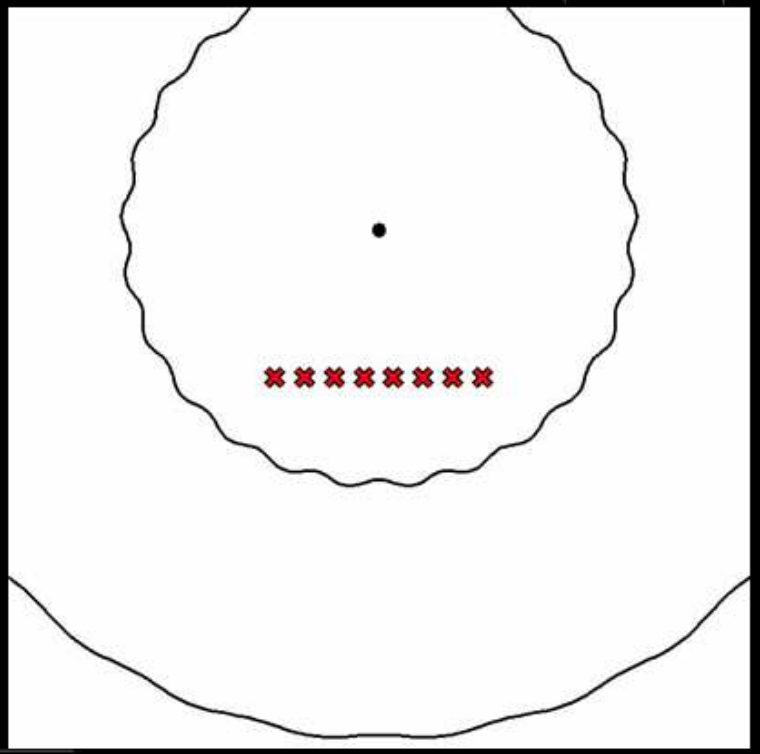
Far-field



Near-field



Localization (Far-field)

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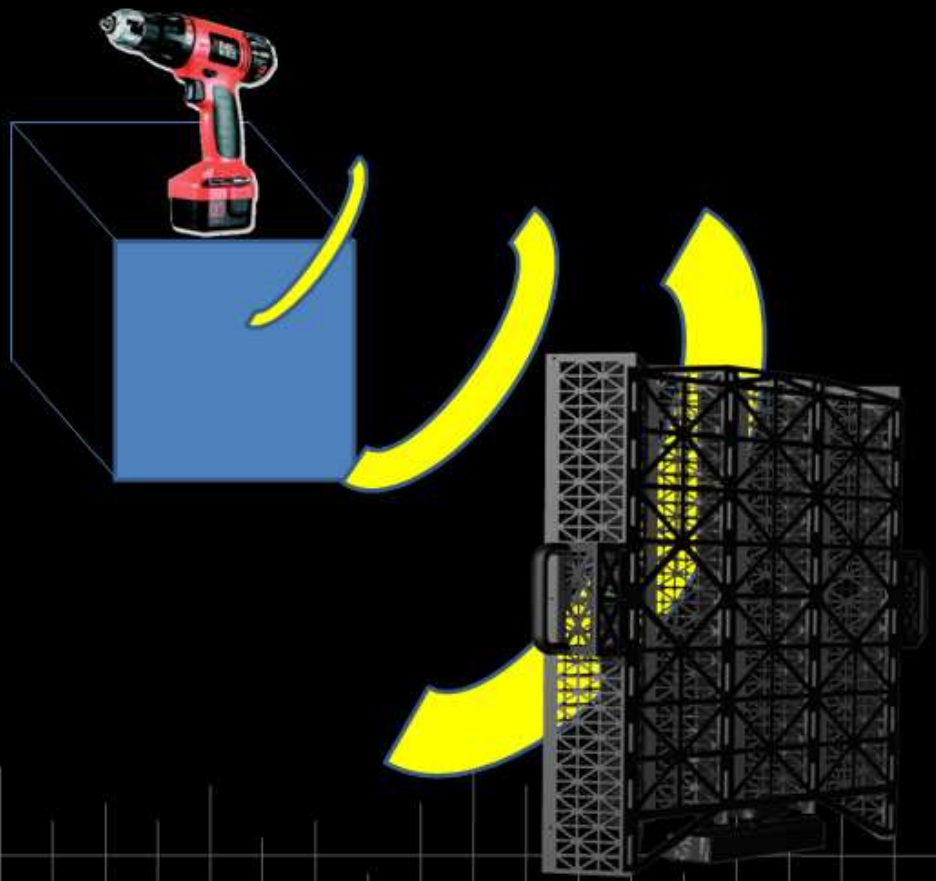

Beam-forming

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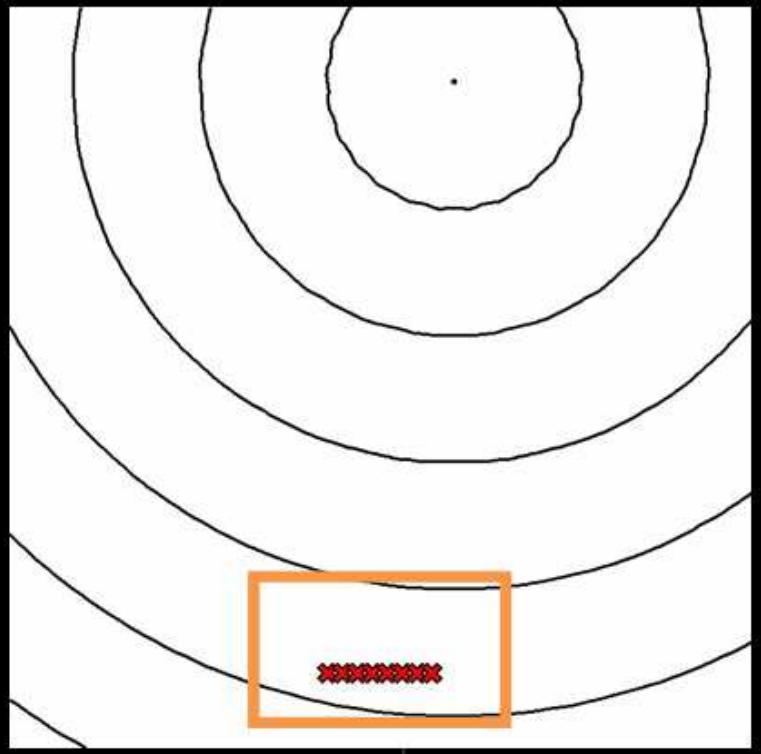

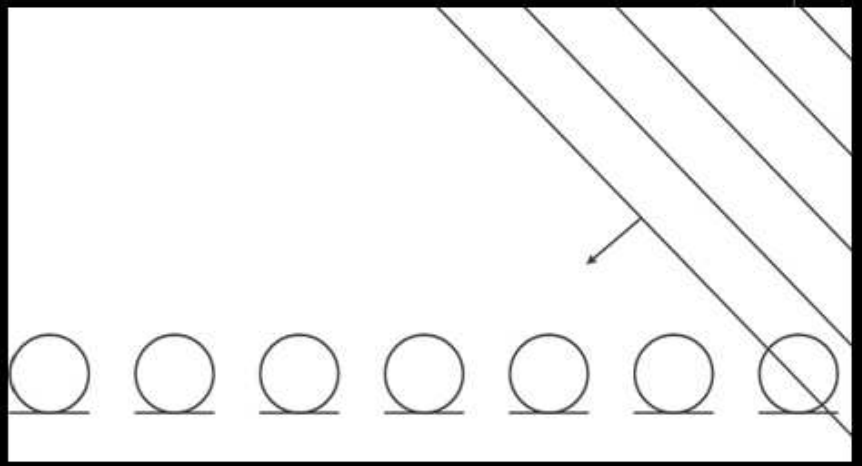

Delay-and-Sum Beam-forming

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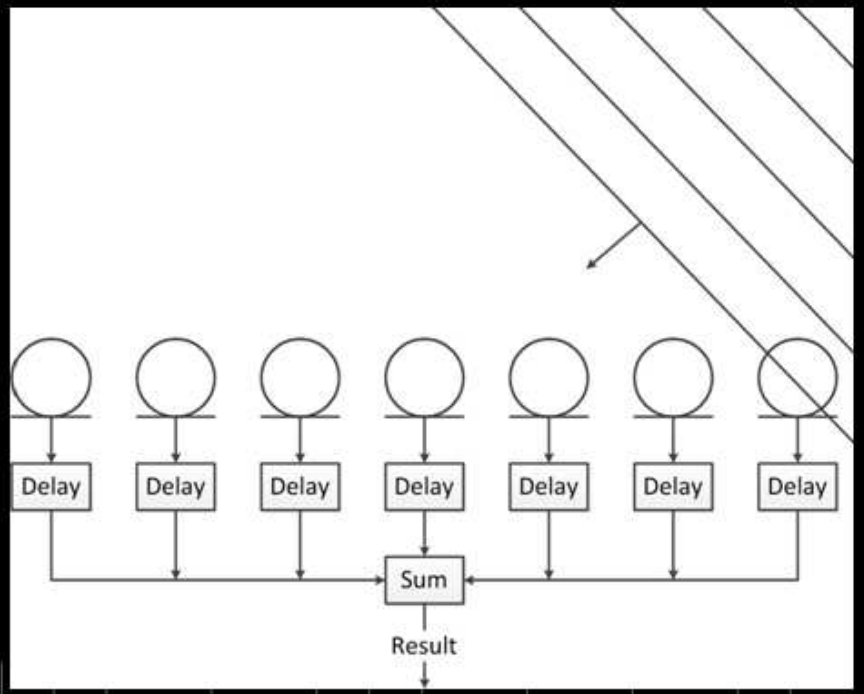

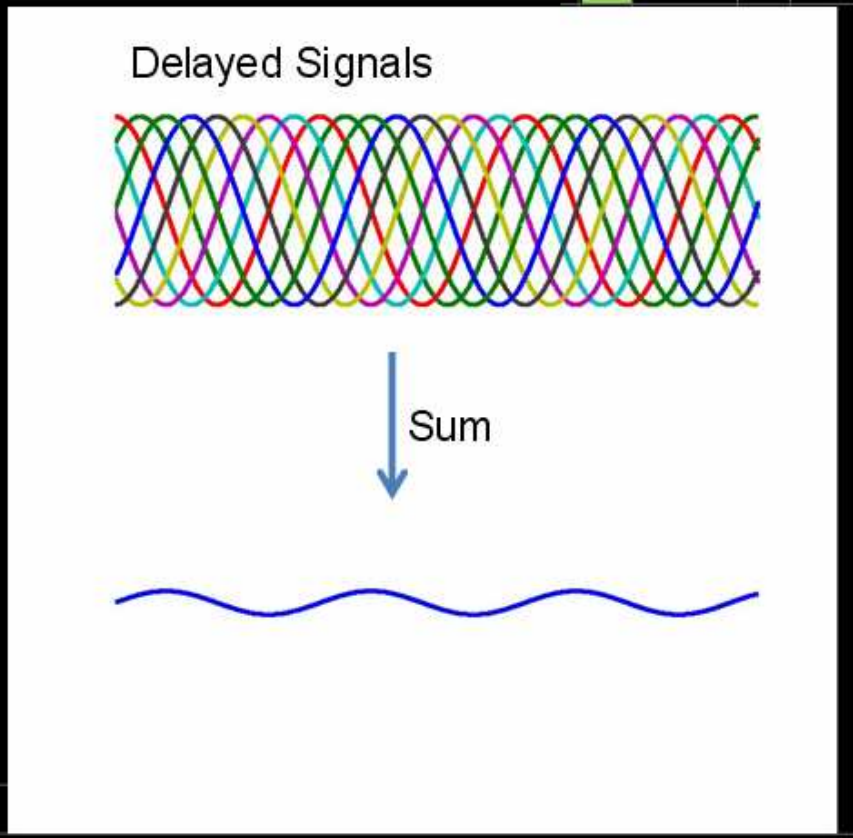

Observation (Near-field)

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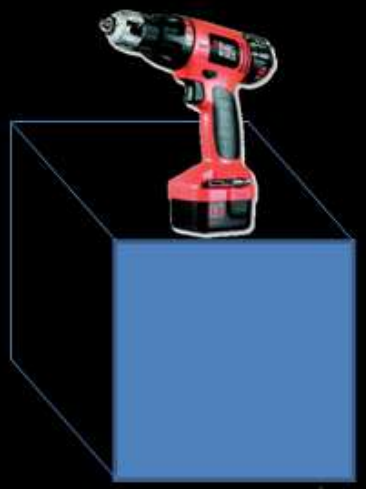
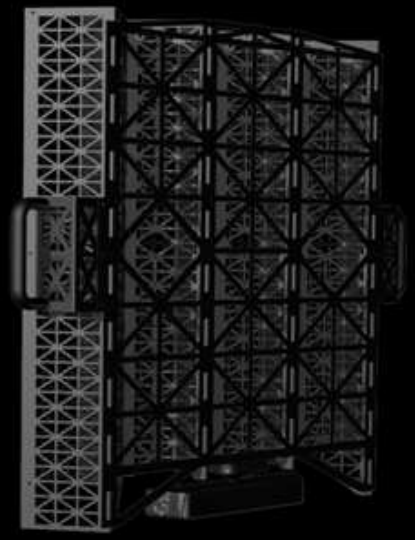
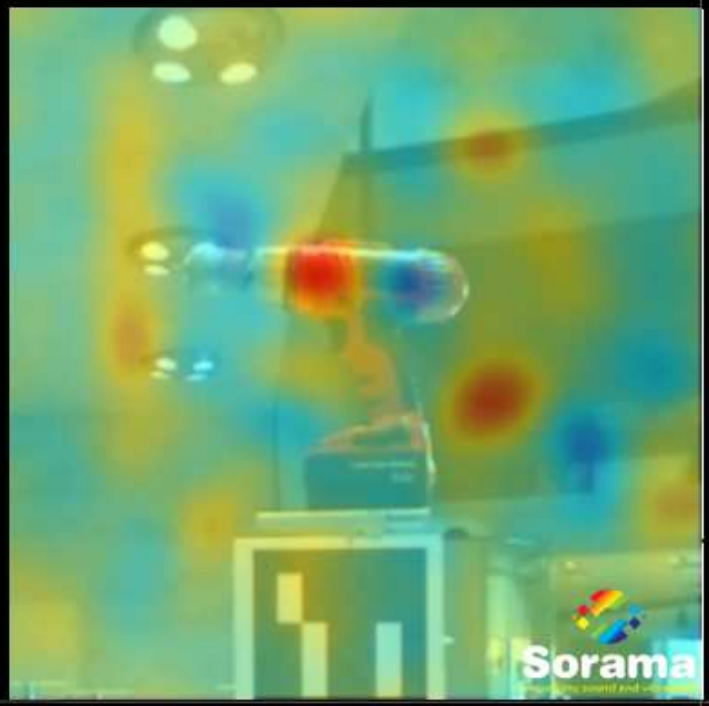
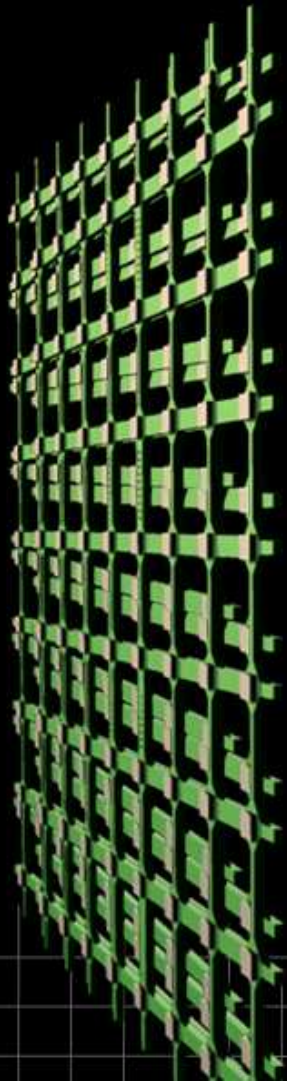




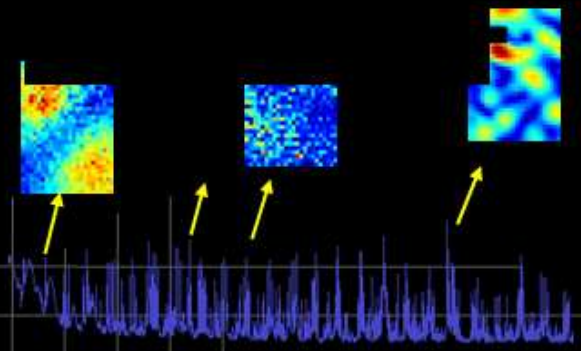
Near-field

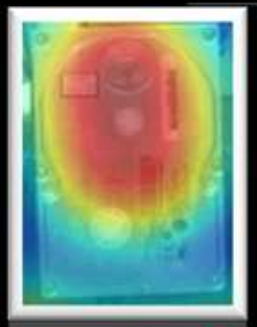


Hologram to Source

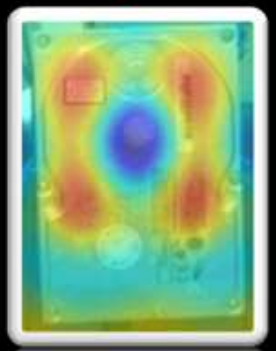


hologram





source



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Digital MEMS microphone array
64-1024 multiplexed channels

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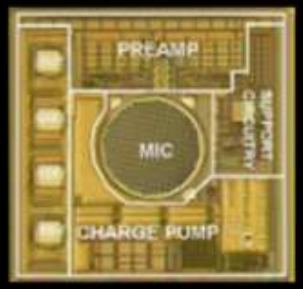
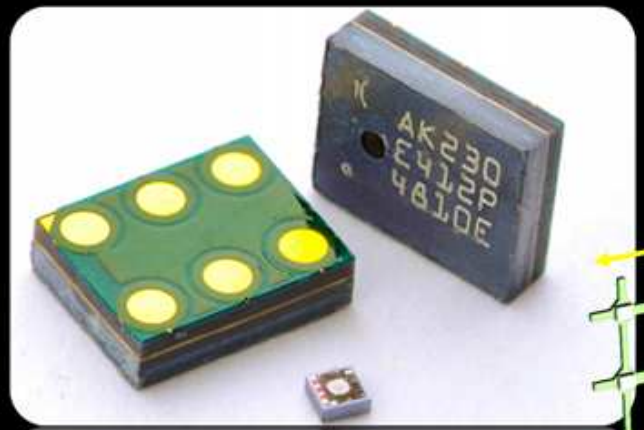
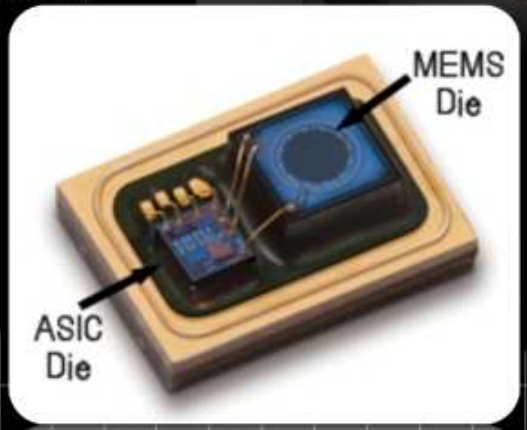
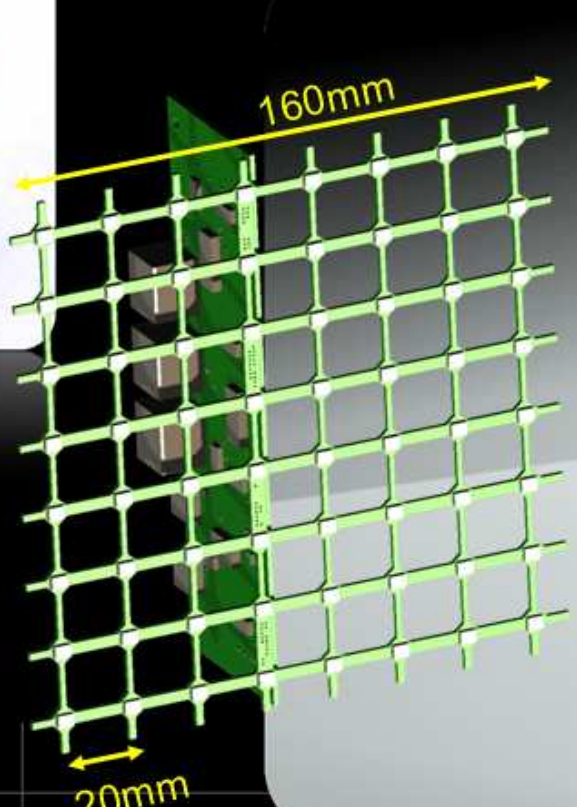


Monolithic CMOS MEMS Microphone Chip

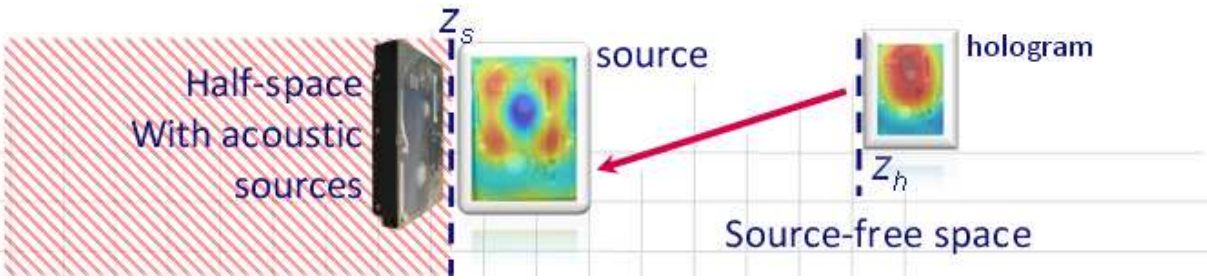




die



Near-Field Acoustic Holography (NAH)



Near-Field Acoustic Holography (NAH)

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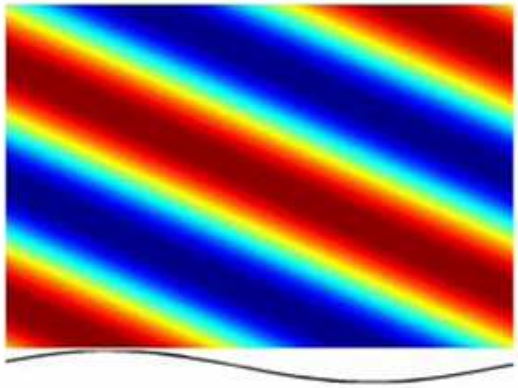

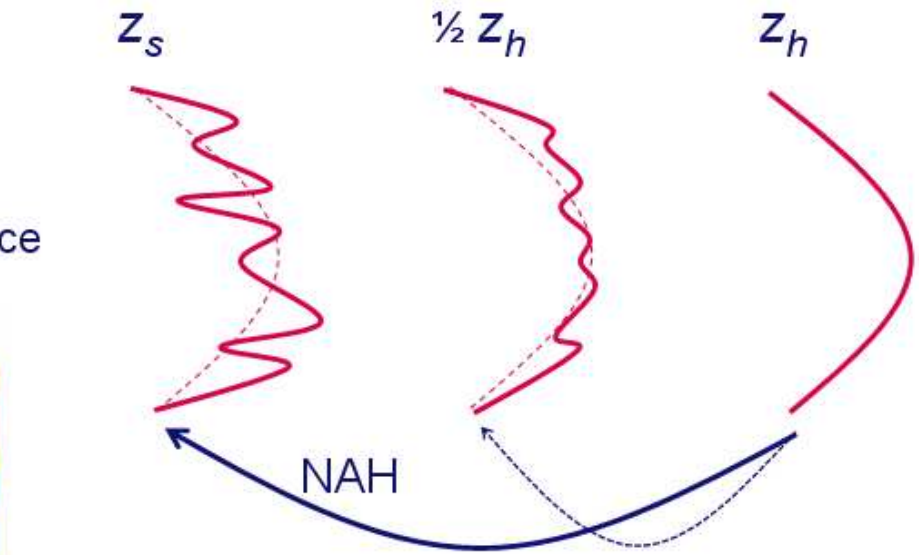

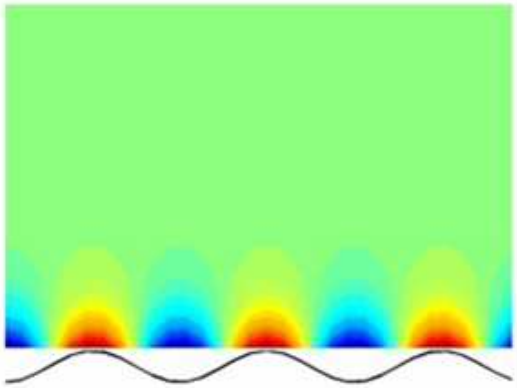

Near-field: propagating & evanescent waves

no decay
phase change

exponential
decay

Sound Imaging Analysis

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Sound source identification & location

Sound source behavior in time & space

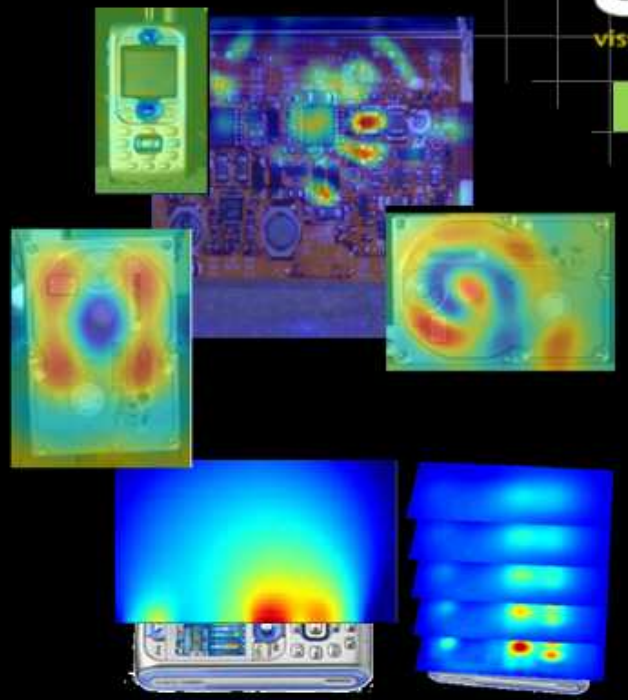
3D sound propagation

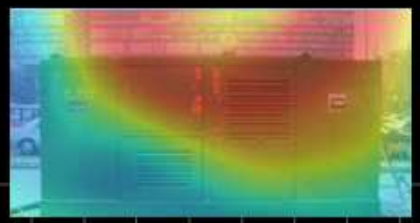
Structural vibration analysis

One Hologram results in:

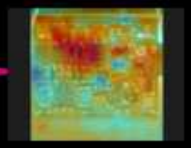
3D Sound Pressure
Particle Velocity
Sound Intensity

over a desired frequency band





large product range



Tuning fork vibrations

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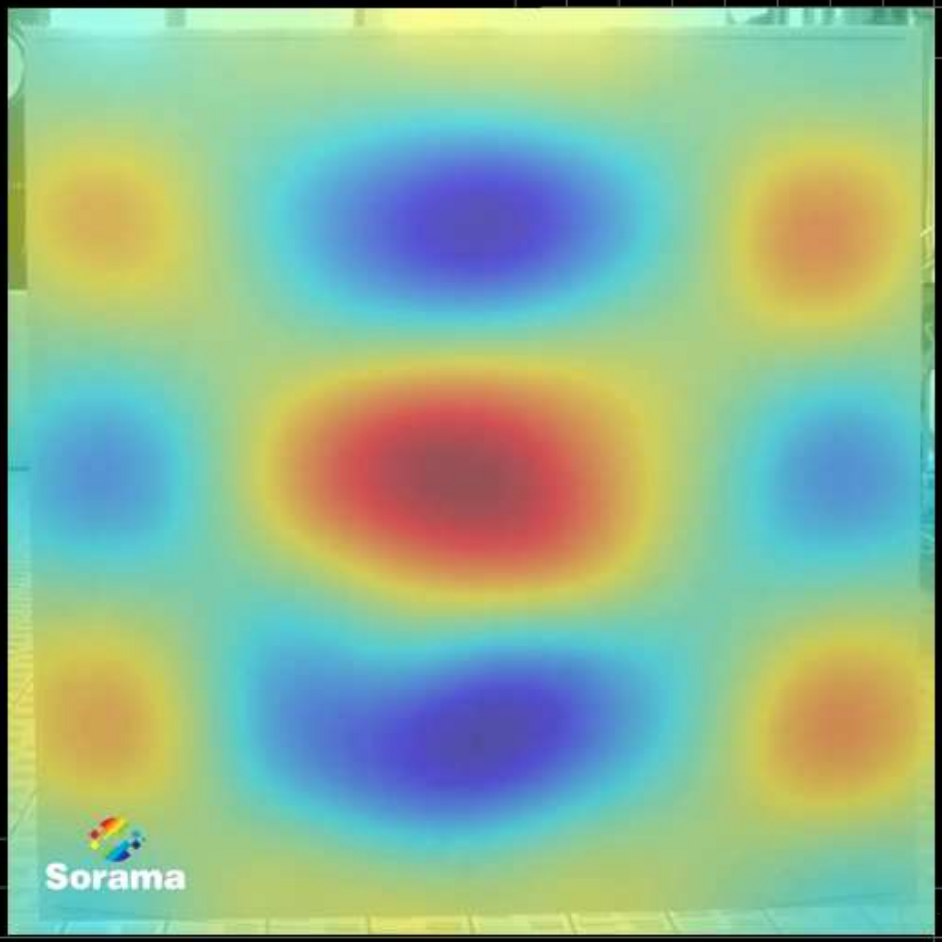

Stiffening

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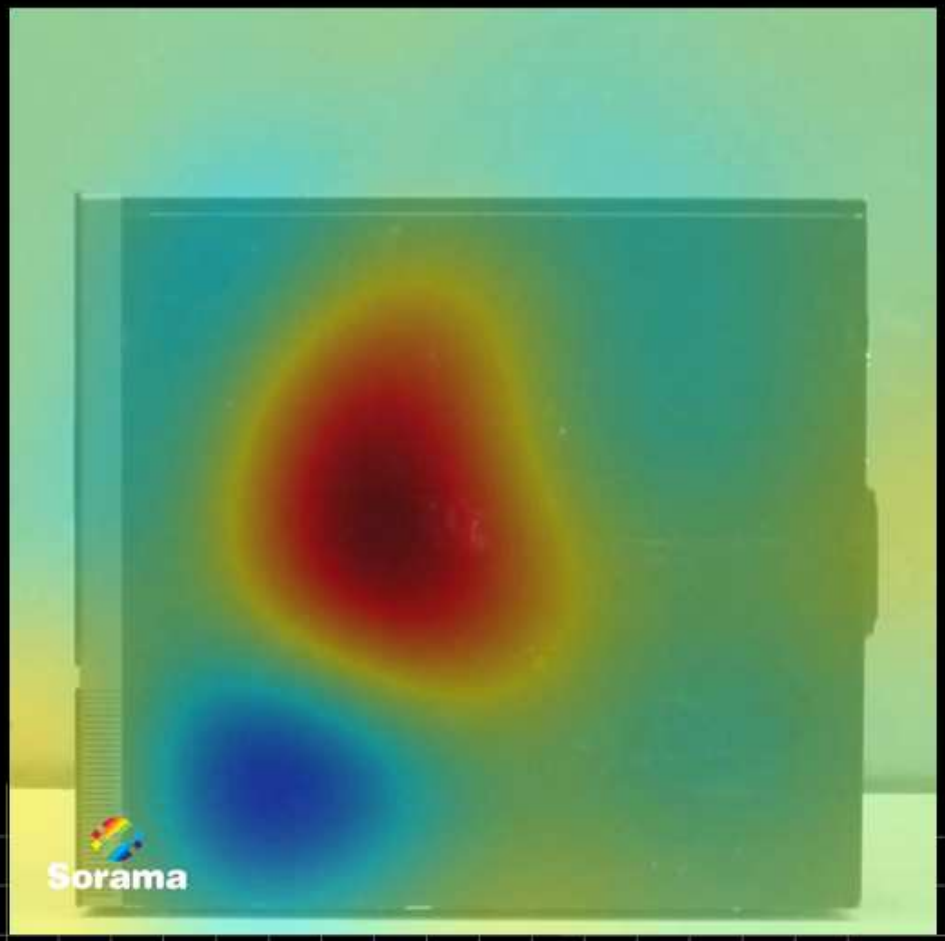

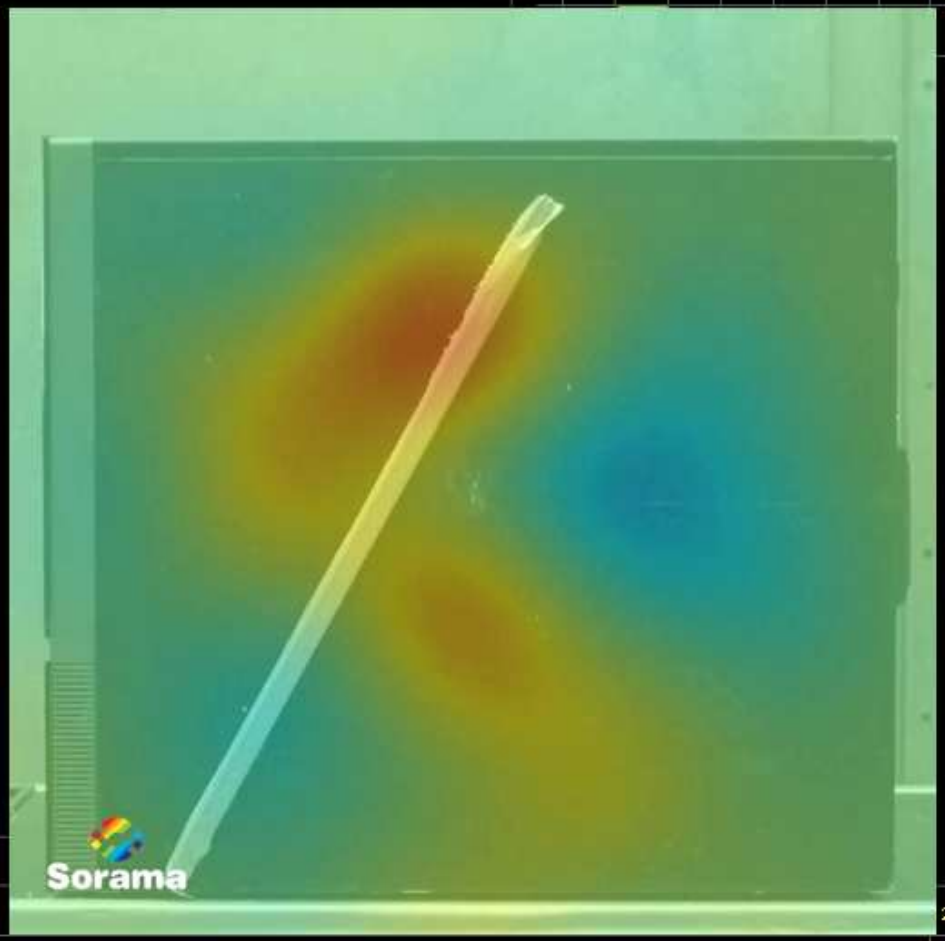

Damping

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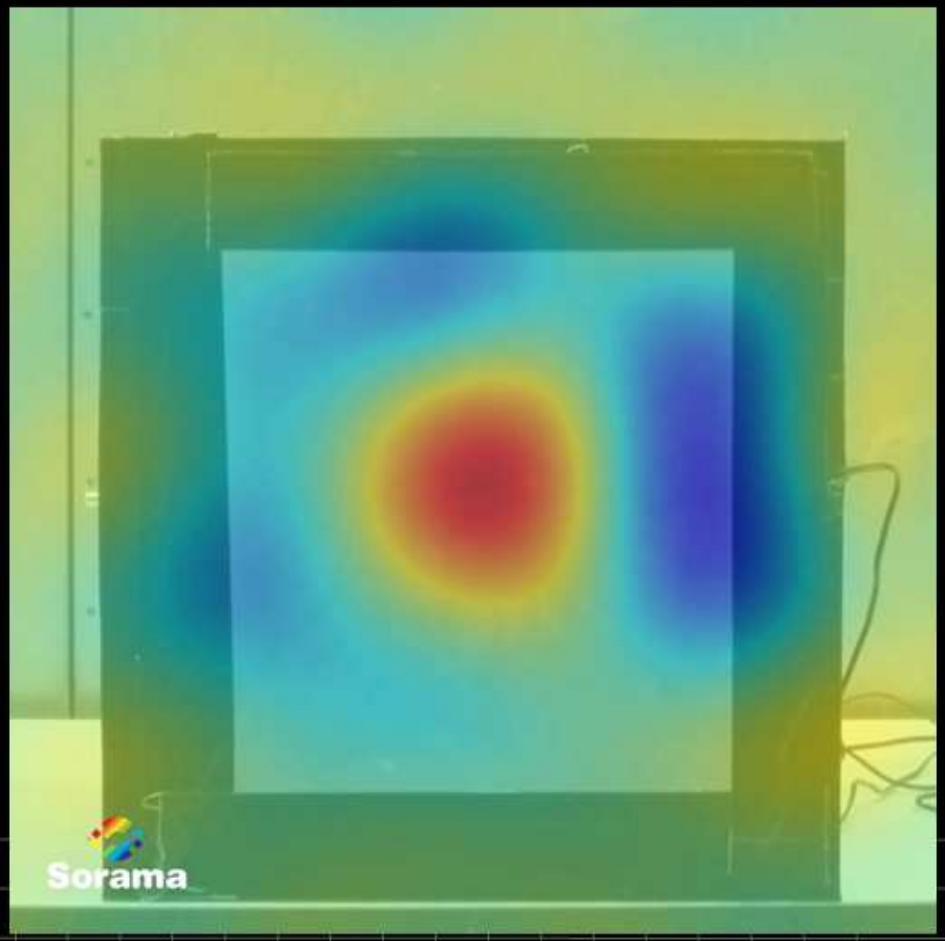

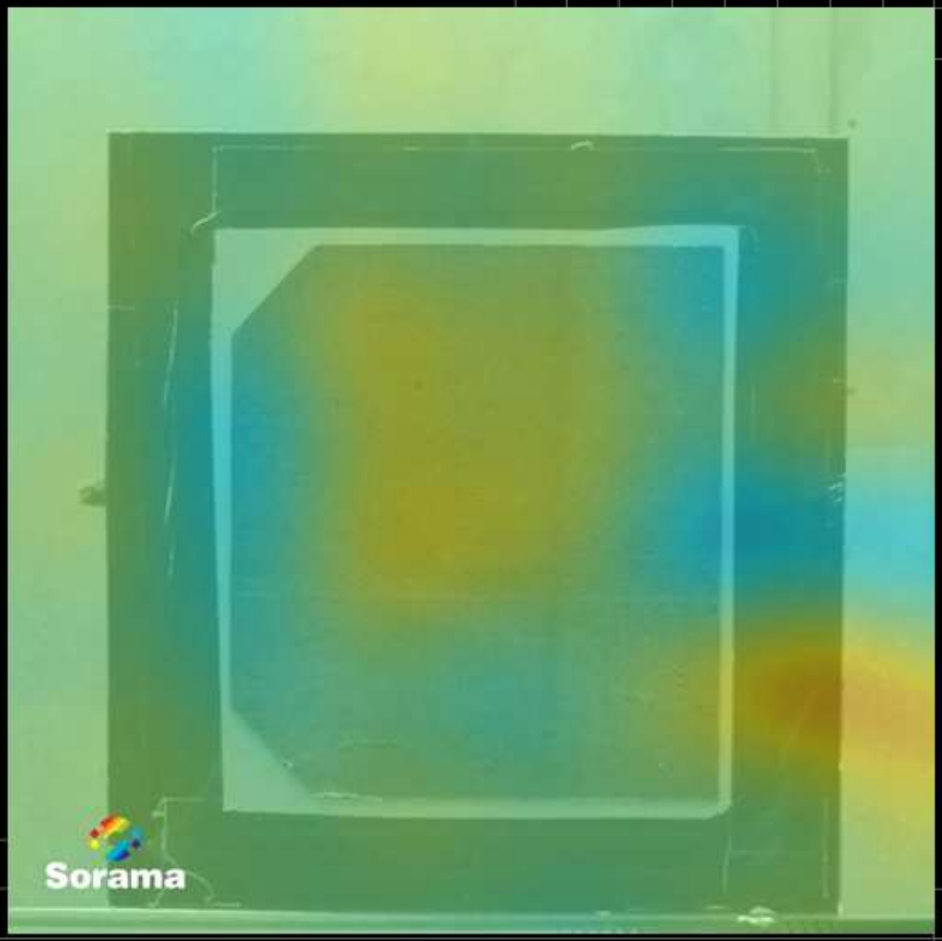

Absorption

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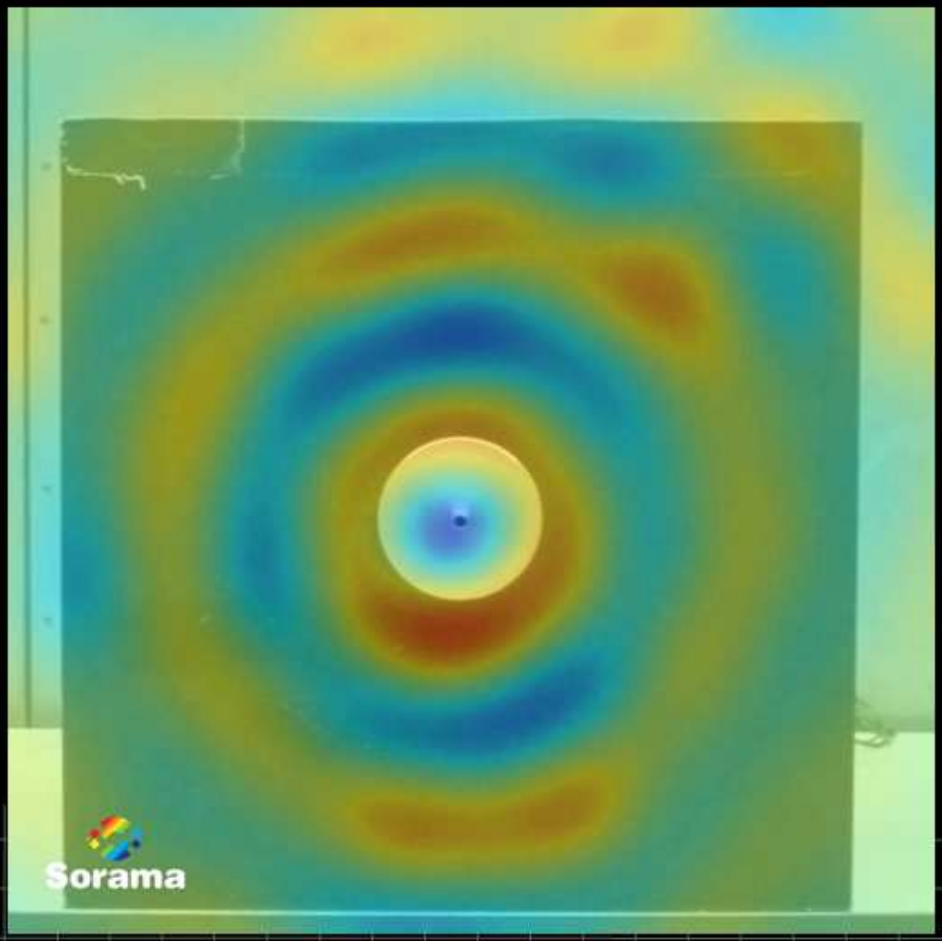

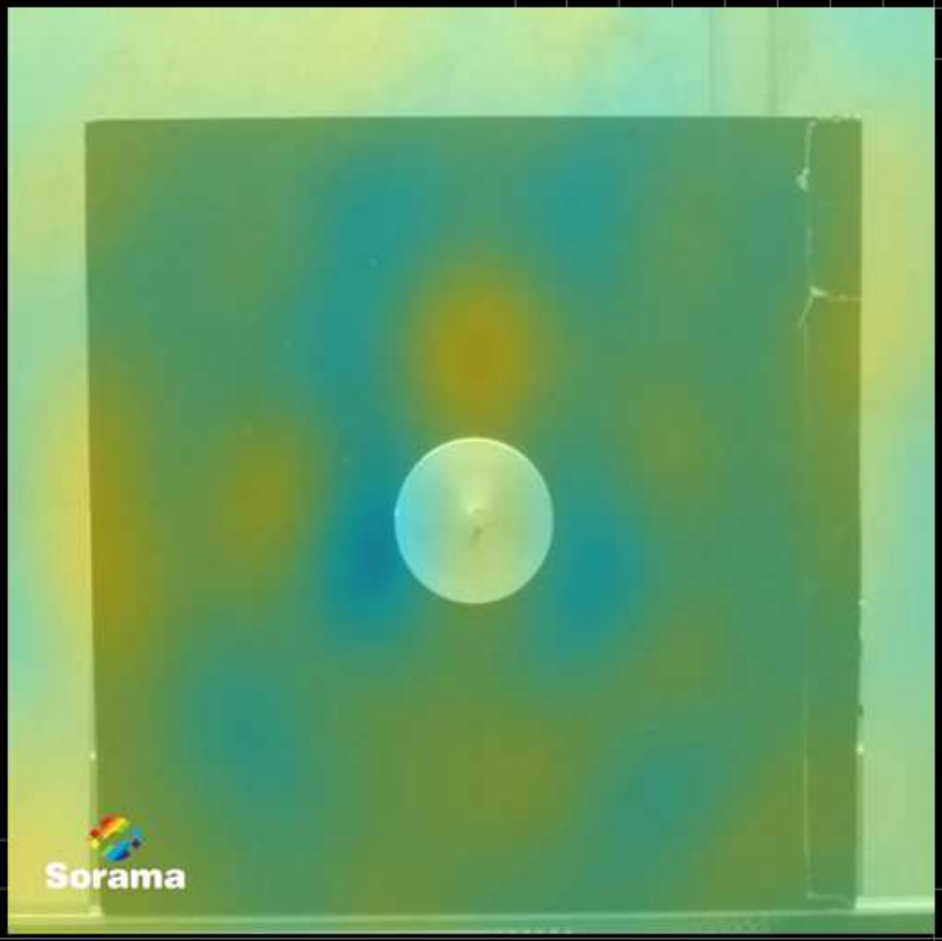

Source path analysis

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Integration: Sorama Portal

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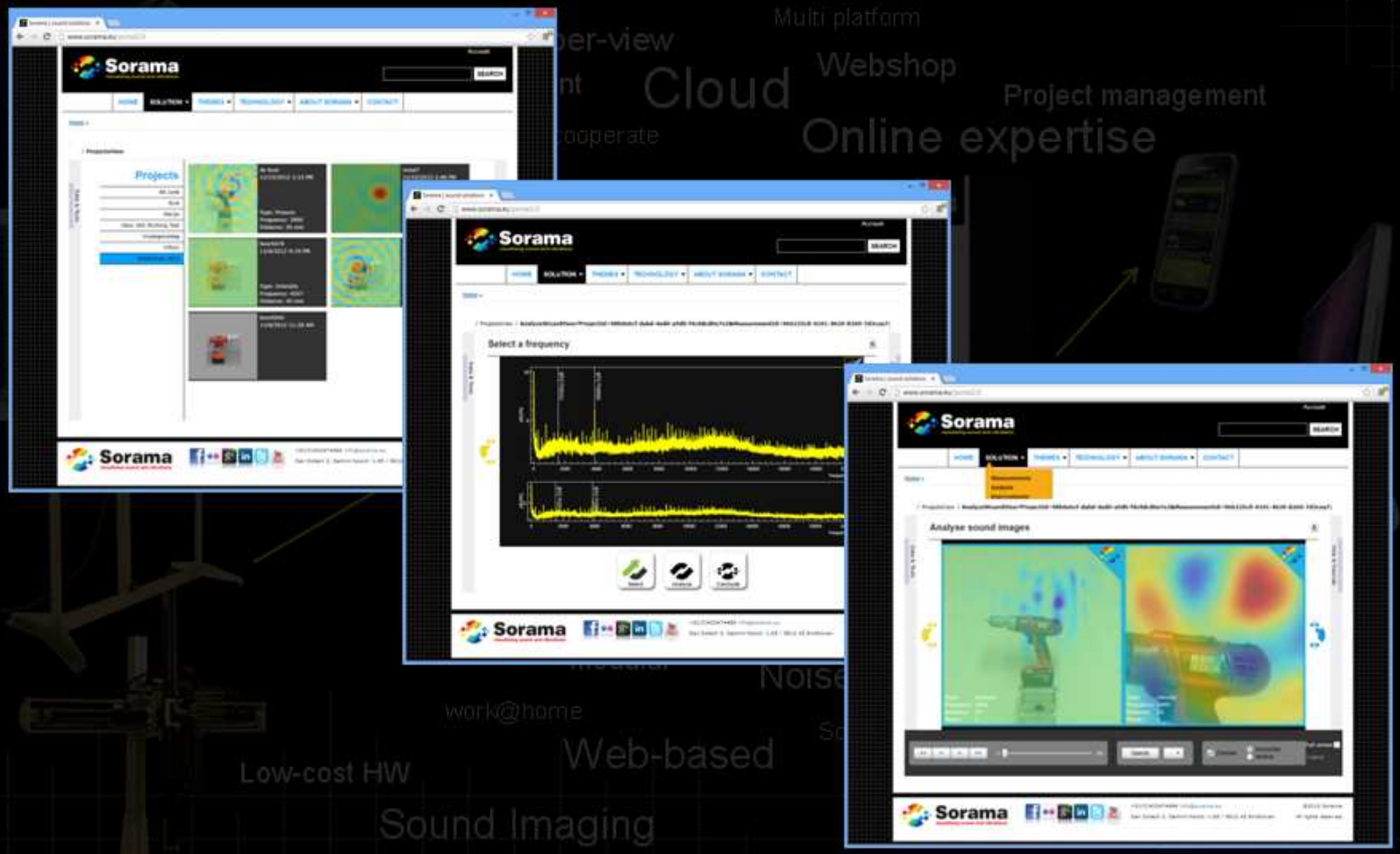

Outreach

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Outreach

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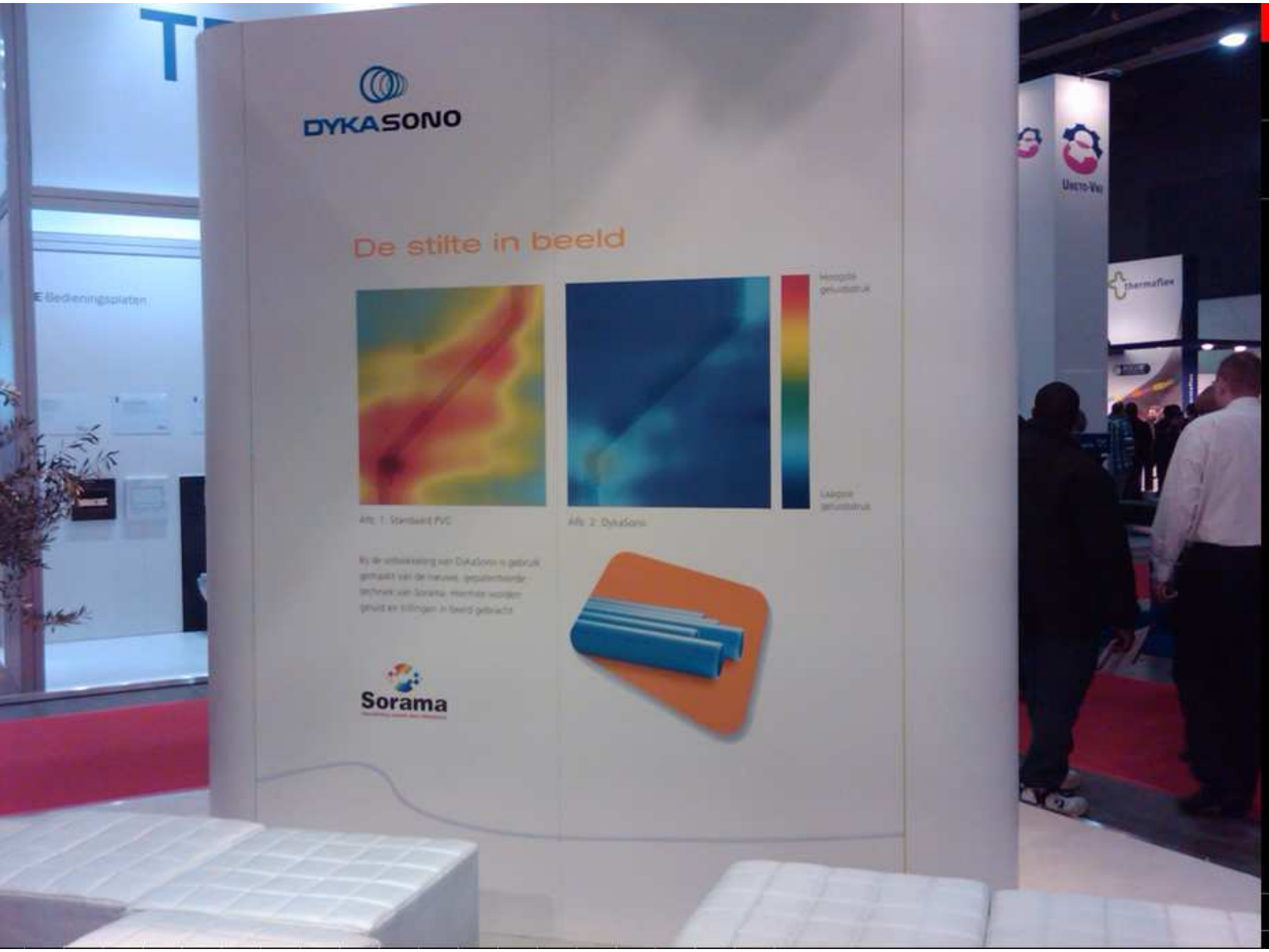

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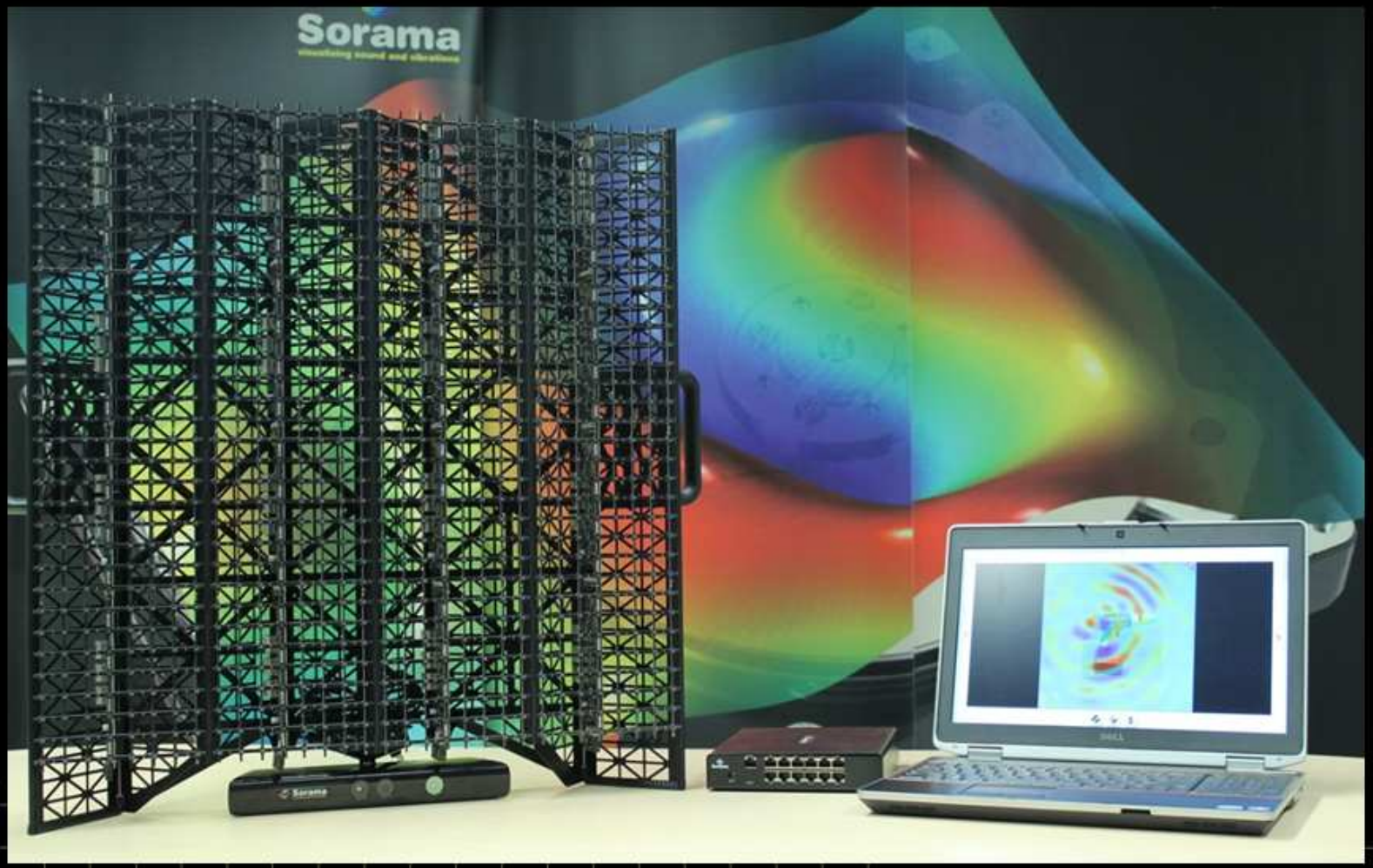
Sorama Cam pilot



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