ACOUSTIC HOLOGRAPHIC VISION

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CERN openlab workshop
11th of November, 2014

Human Echolocation

and its technological reproduction

Reality:

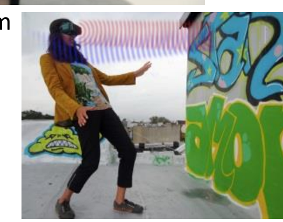
smithsonianmag.com

"the visually impaired"

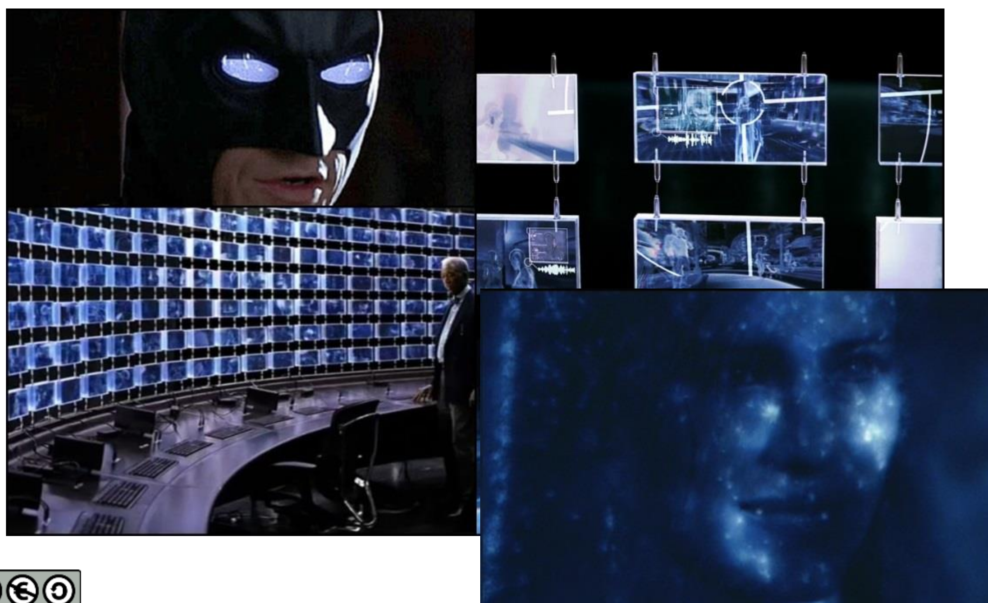
entretags.de

CERN fire training (Anna Pantelia)

aisencaro.com



Vision:



What to aim for?

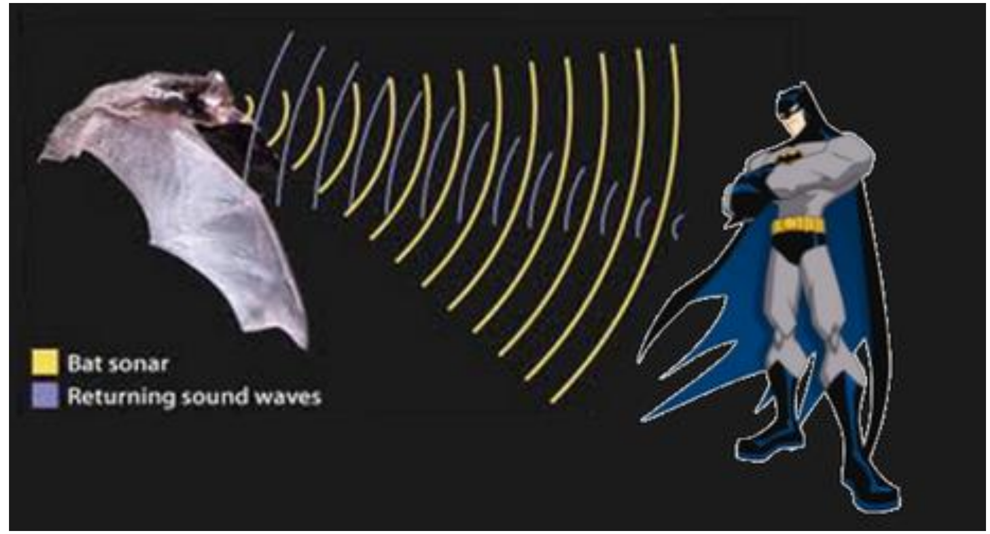
Animal Echolocation

Ultrasound is better:

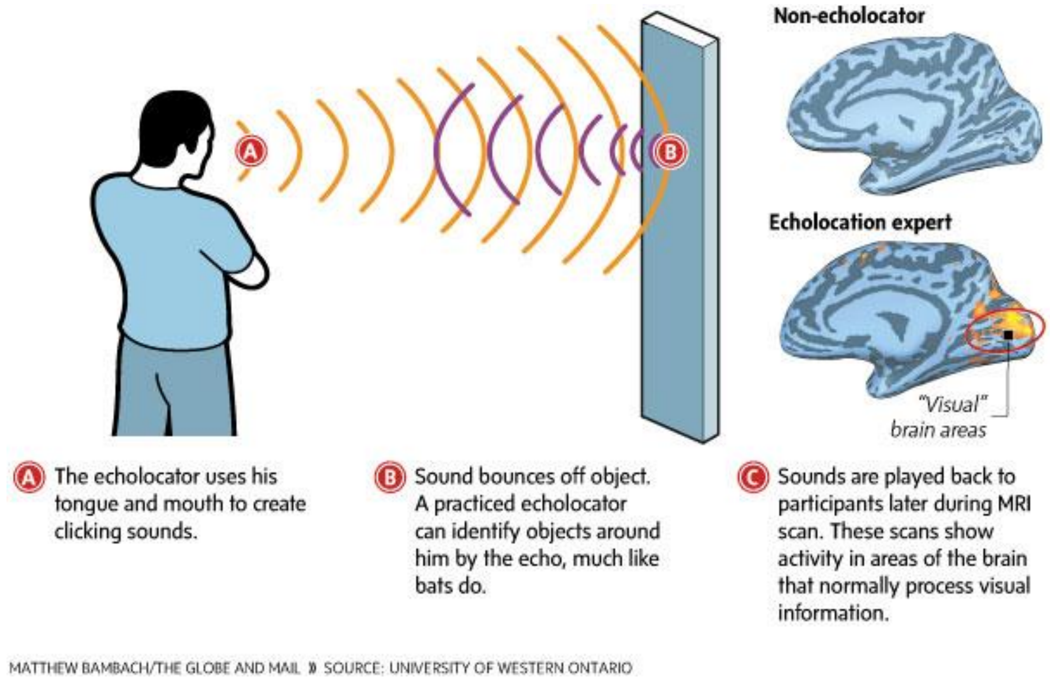
Distance
Speed (acquisition)
Directional

Neuroscience:

Visual areas involved imply advanced scene reconstruction, but no accepted neural theory



adurkin.weebly.com



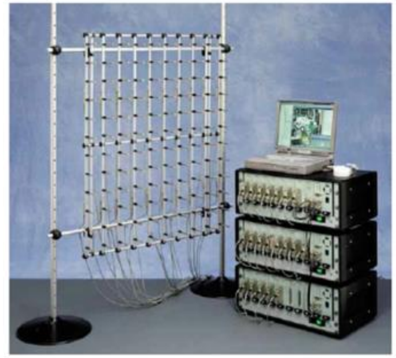
Acoustic Holography

Issues:

1. Resolution
2. Processing power

Proposed solutions:

1. Compressive sensing via sparsity
2. Real-time cloud services


Real-time Near-field Acoustic Holography

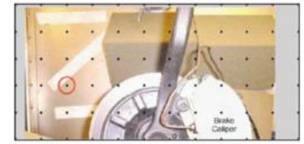


Figure 9. Measurement area with indication of array microphone positions (dots).

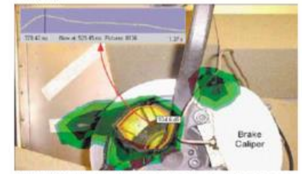


Figure 12. Contour plot of envelope active intensity. A time slice representing the position of the contour cursor is included. The contour interval is 1 dB.

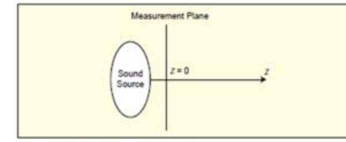


Figure 4. Measurement geometry.

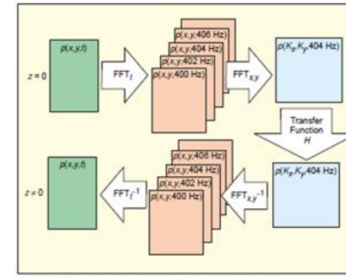


Figure 5. Data flow chart for time domain holography.

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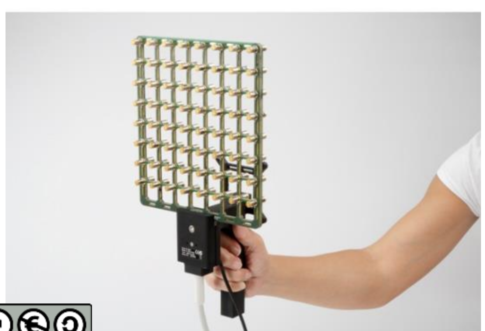
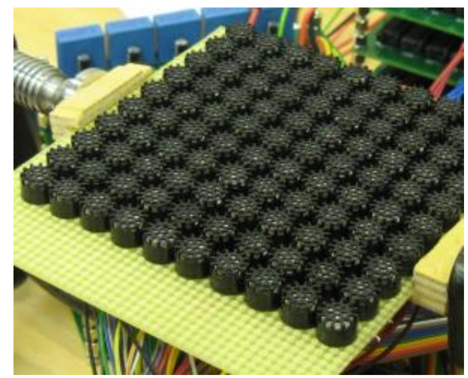
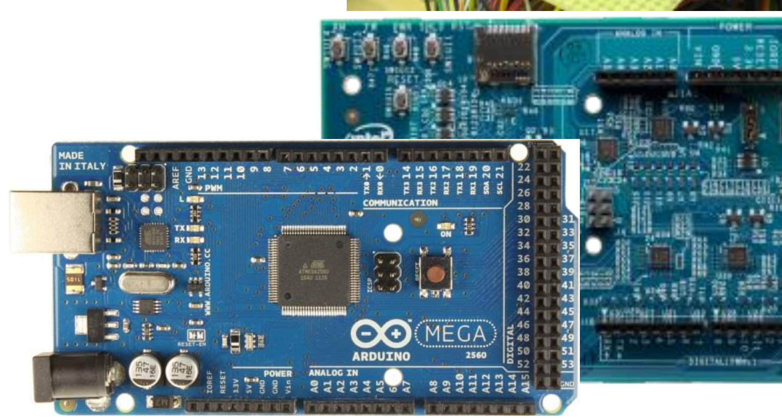
SOUND AND VIBRATION/FEBRUARY 2001

New mobile devices with cloud services

How mobile?

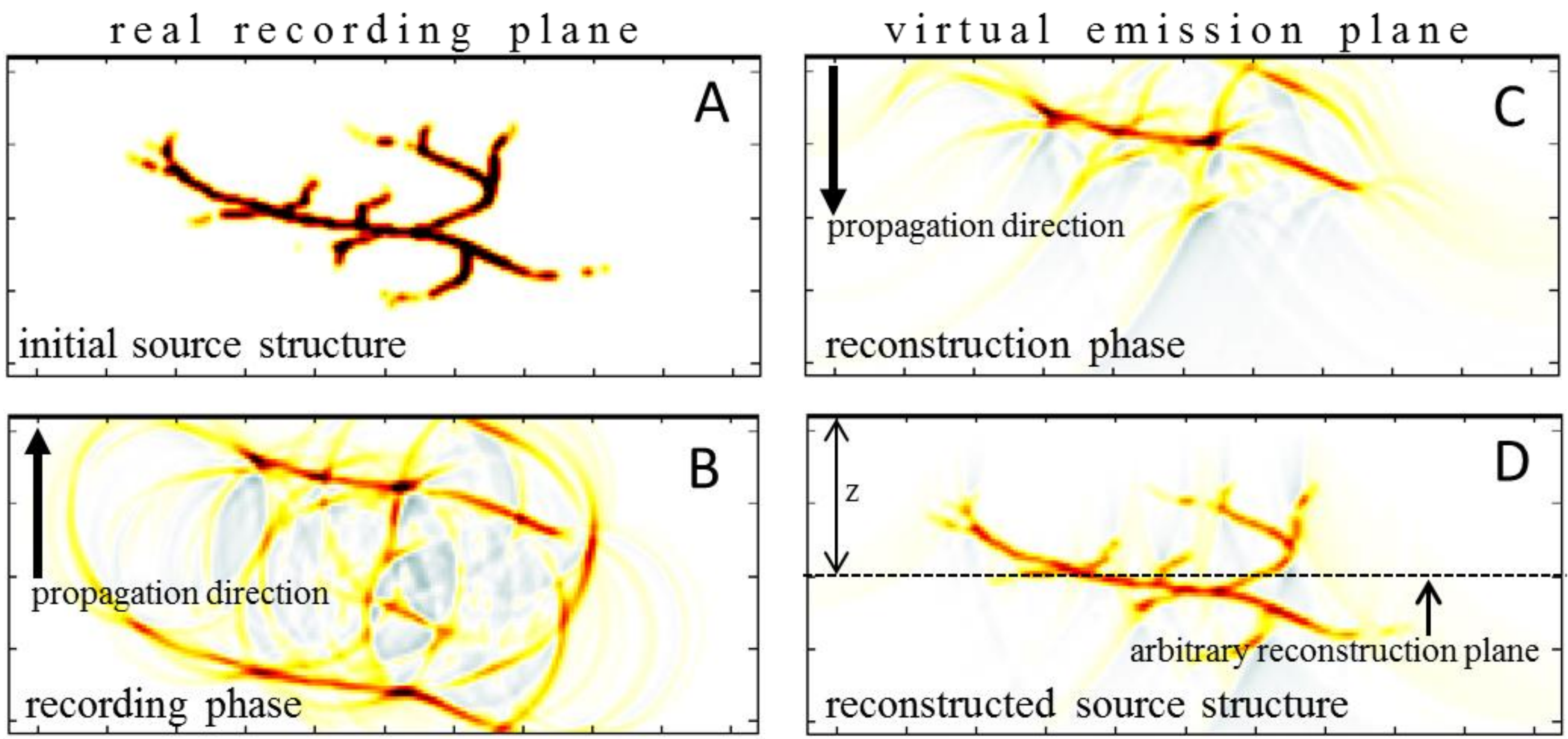






Acoustic Holography

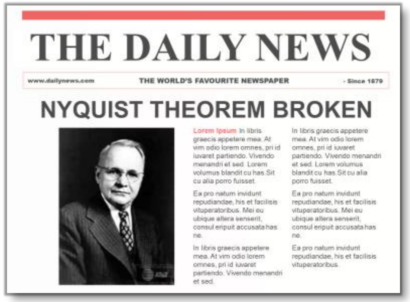
Simulation example (one dimension suppressed):

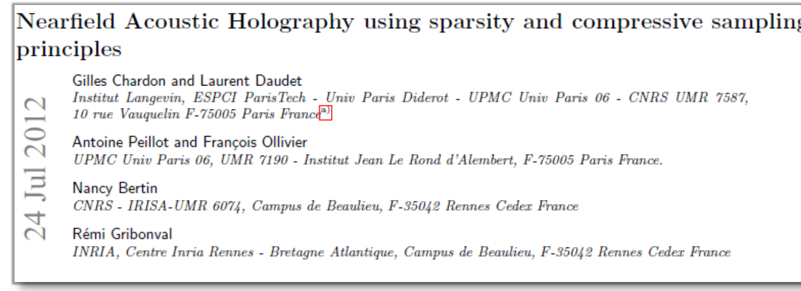


K-WAVE Matlab Toolbox

Acoustic Holography with Compressive Sensing

Based on:




Nearfield Acoustic Holography using sparsity and compressive sampling principles

24 Jul 2012

Gilles Chardon and Laurent Daudet
Institut Langevin, ESPCI ParisTech - Univ Paris Diderot - UPMC Univ Paris 06 - CNRS UMR 7587, 10 rue Vauquelin F-75005 Paris France[a]

Antoine Peillot and François Ollivier
UPMC Univ Paris 06, UMR 7190 - Institut Jean Le Rond d'Alembert, F-75005 Paris France.

Nancy Bertin
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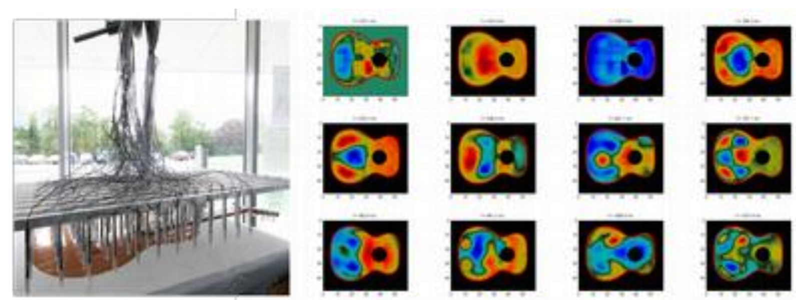
Rémi Gribonval
INRIA, Centre Inria Rennes - Bretagne Atlantique, Campus de Beaulieu, F-35042 Rennes Cedex France

What is compressive sensing?

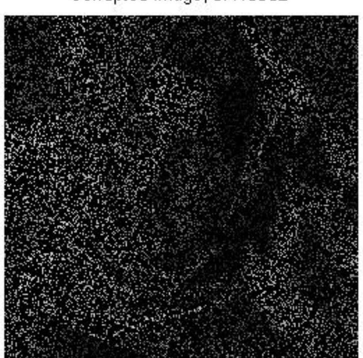
Sparsity is required (compressible)

Random sampling is key



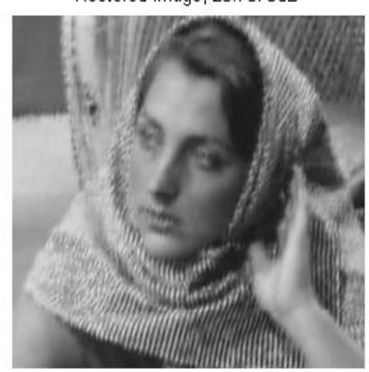
Example:

Corrupted image, 6.4106dB



Original image

Restored image, 26.7876dB



Can we implement it?

Code from: "Non-Parametric Bayesian Dictionary Learning for Sparse Image Representations," Neural Information Processing Systems (NIPS), 2009.

Near-field Electromagnetic Holography

MEA ELECTROMAGNETIC INCOHERENT NEAR-FIELD HOLOGRAPHY

for

super-resolution

spike localization and sorting in 3D

energy flow and dissipation

current source density, energy source density

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Venue

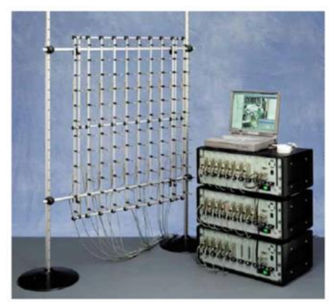
September, 2013

Most recent work in experimental neuroscience

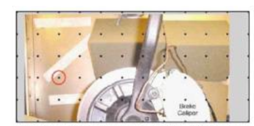
Background

Translation of known technique:

Near-field Acoustic Holography (NAH)



Real-time Near-field Acoustic Holography



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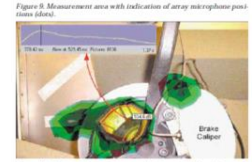

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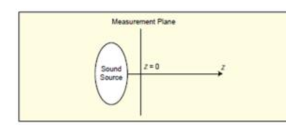

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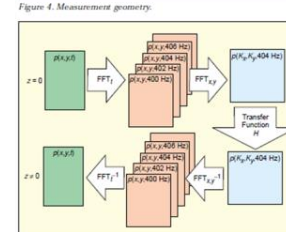

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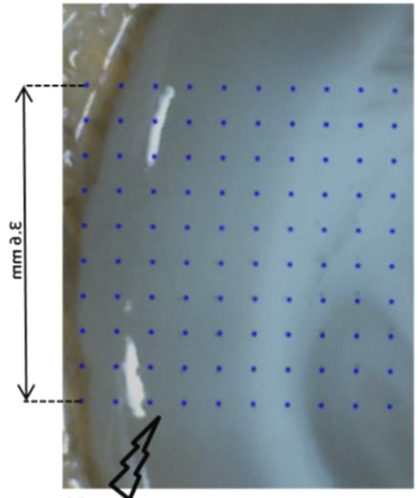
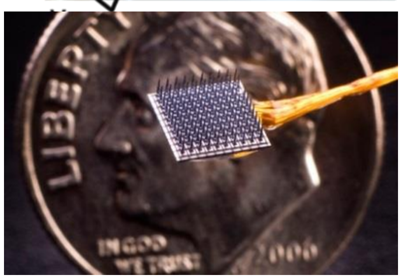
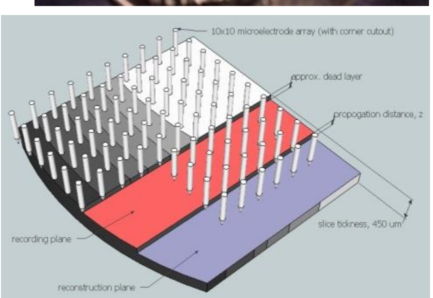
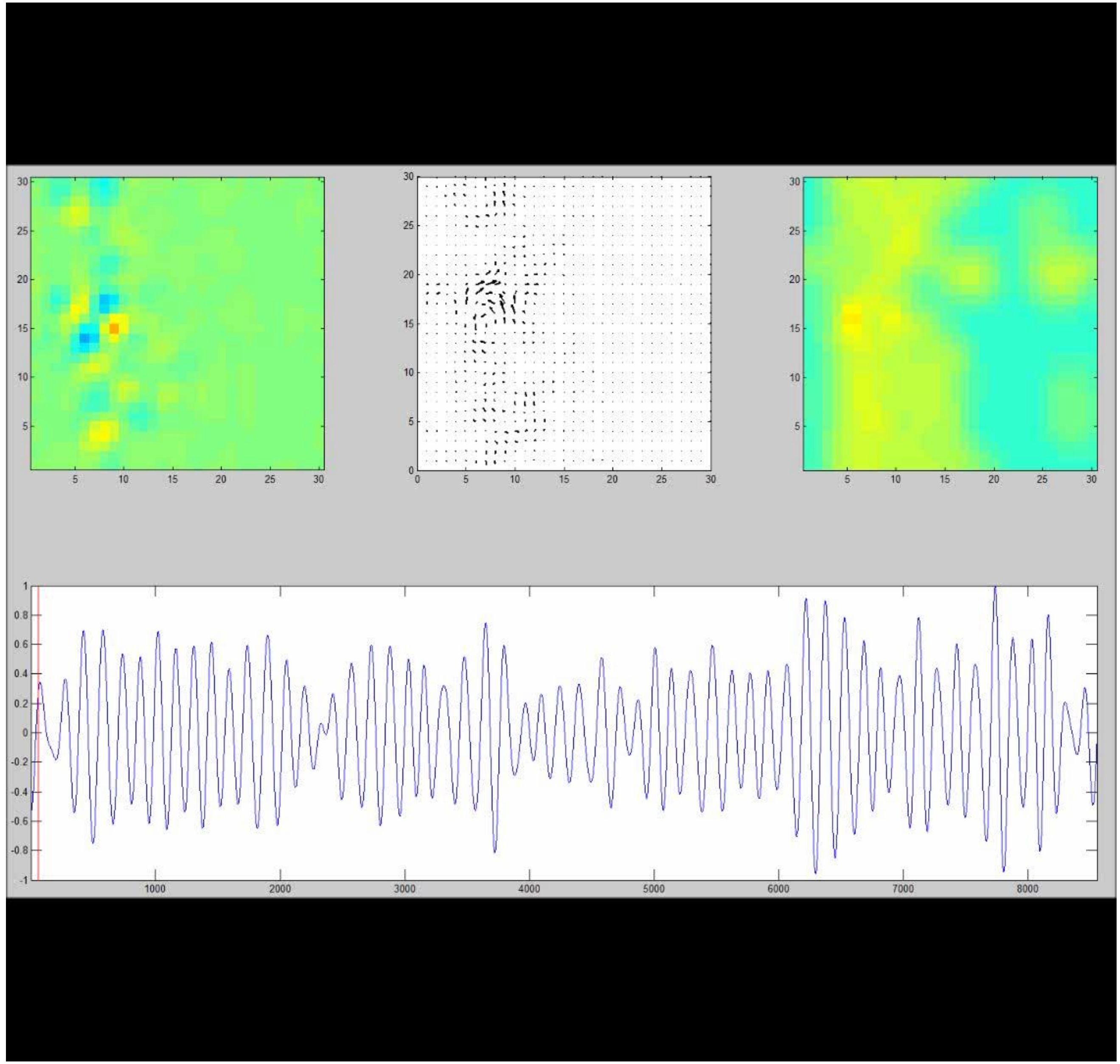
Proven implementation of a generalization of acoustic holography

Example





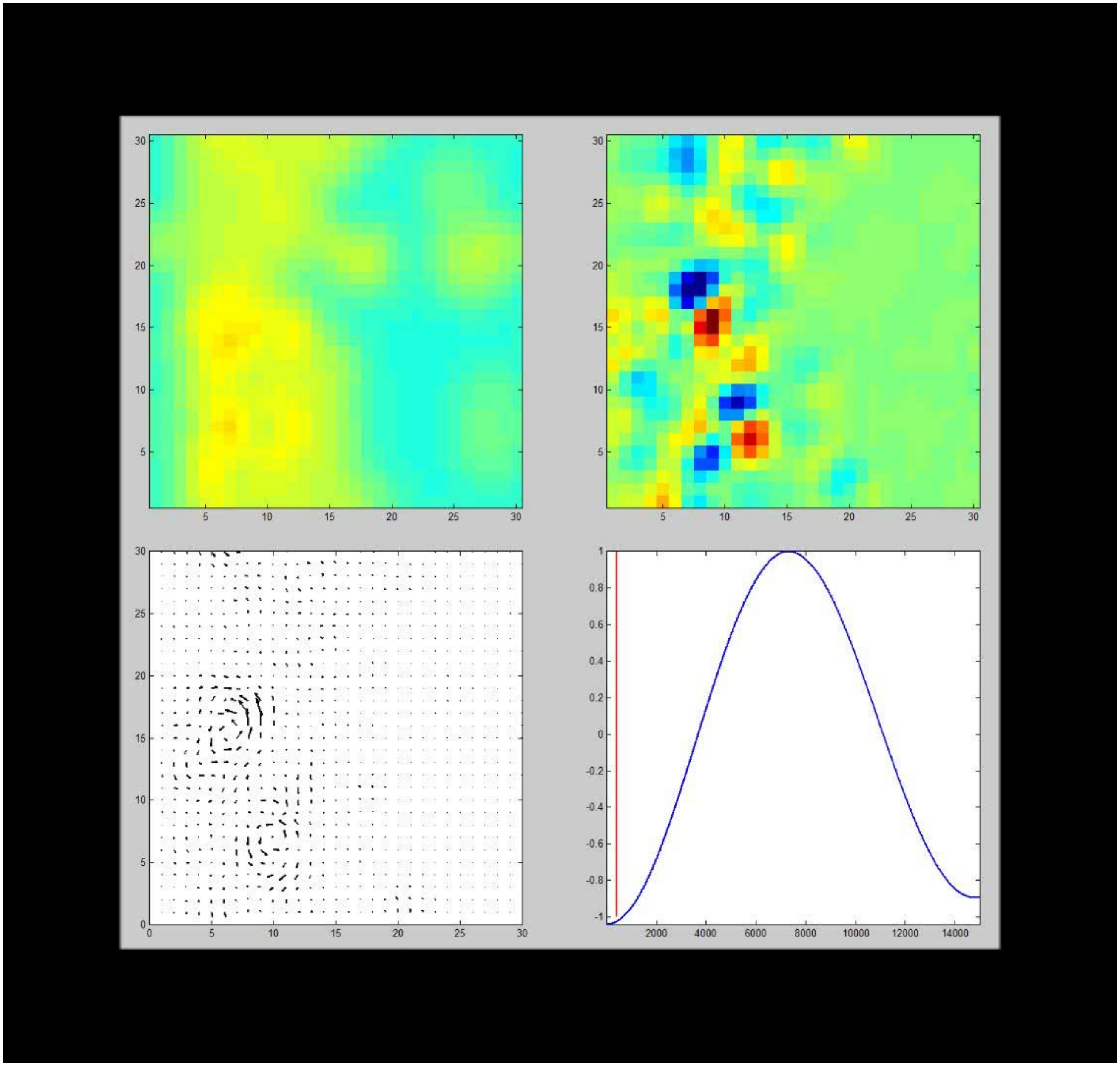




Super-resolution: x3

Example

Energy flow reveals network causality patterns



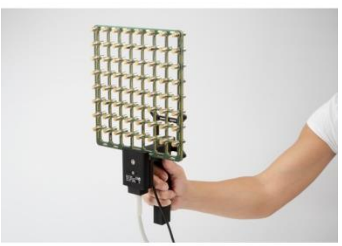
phase-locked average of previous clip

Acoustic Holographic Vision

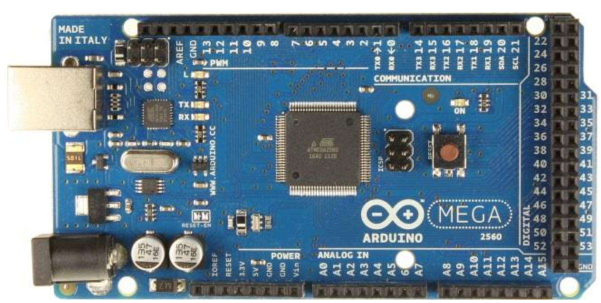
DESIGN SPECIFICATION OUTLINE:

Ultrasound holography with super-resolution via compressed sensing and real-time cloud services

Mobility



Computability



Quality

Recognition
Navigation
Response

Acknowledgements

Marcus Kaiser and Newcastle Dynamic Connectome Lab

Miles Whittington and York Oscillations Group

Gary Green and York Neuroimaging Centre

Marco Manca and CERN Medical Applications

SciPulse foundation

Newcastle University

ION The Institute of Neuroscience

wellcome trust