ChiRoPing: Robust and Versatile Embodied Active Sonar Sensing

John Hallam

john@mmmi.sdu.dk

The Maersk Mc-Kinney Moller Institute

University of Southern Denmark

Odense, Denmark

Project Goal

Robust and versatile embodied active sonar systems able to complement vision

Bat Diversity: Shape, Sound and Behaviour

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J.C.T. Hallam

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  - flight, shape and acoustic control loops
- Embodiment is crucial
  - Static and dynamic shape for pre-filtering
  - Orienting and flightpath choices

How do bats ‘work’?

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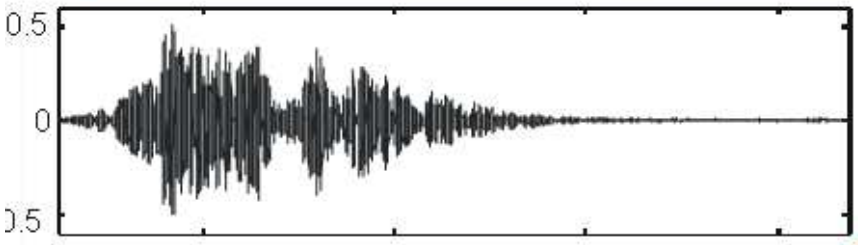
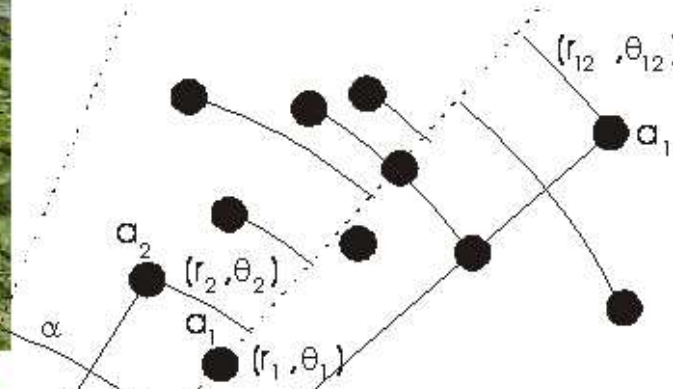
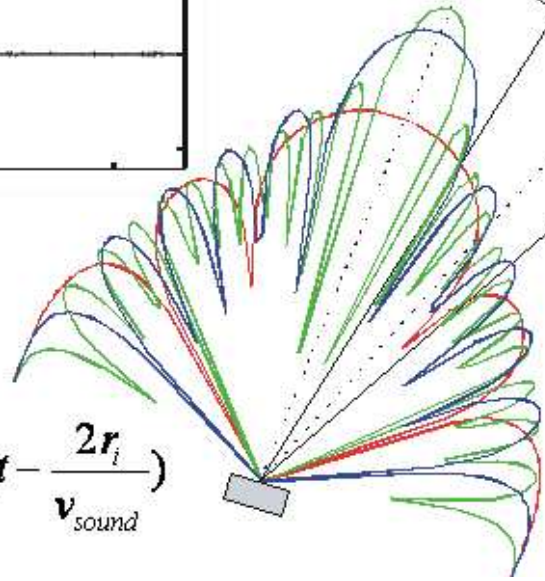


$$N_{refl}, r_i, \theta_i, a_i$$





3D reality

1D representation

$$\sum_{i=1}^{N_{refl}} h_{tr-rec}(t,\alpha,\theta_i) * a_i h_{leaf\,i}(t) * s_{call}(t - \frac{2r_i}{v_{sound}})$$

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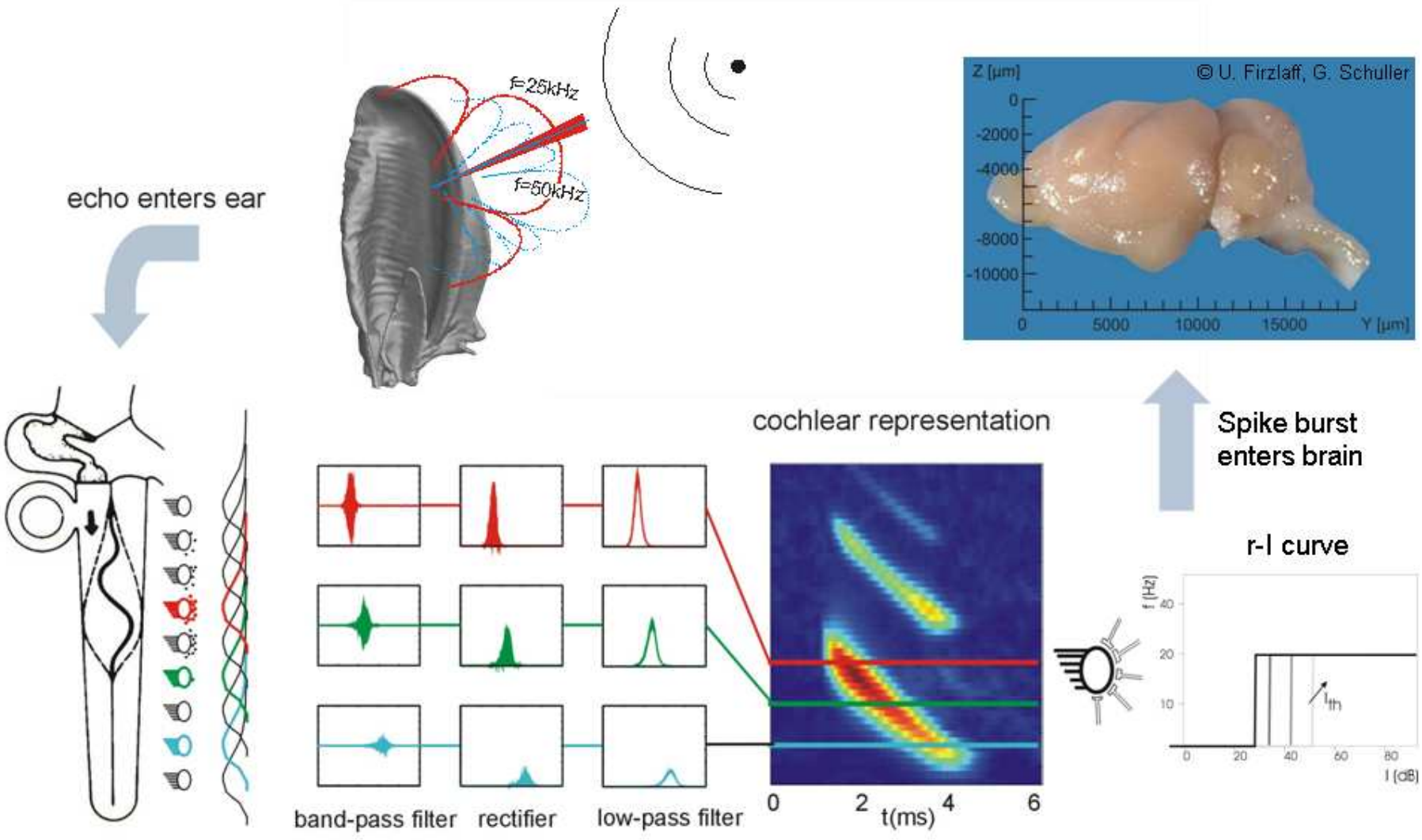

Shape — Current Technology

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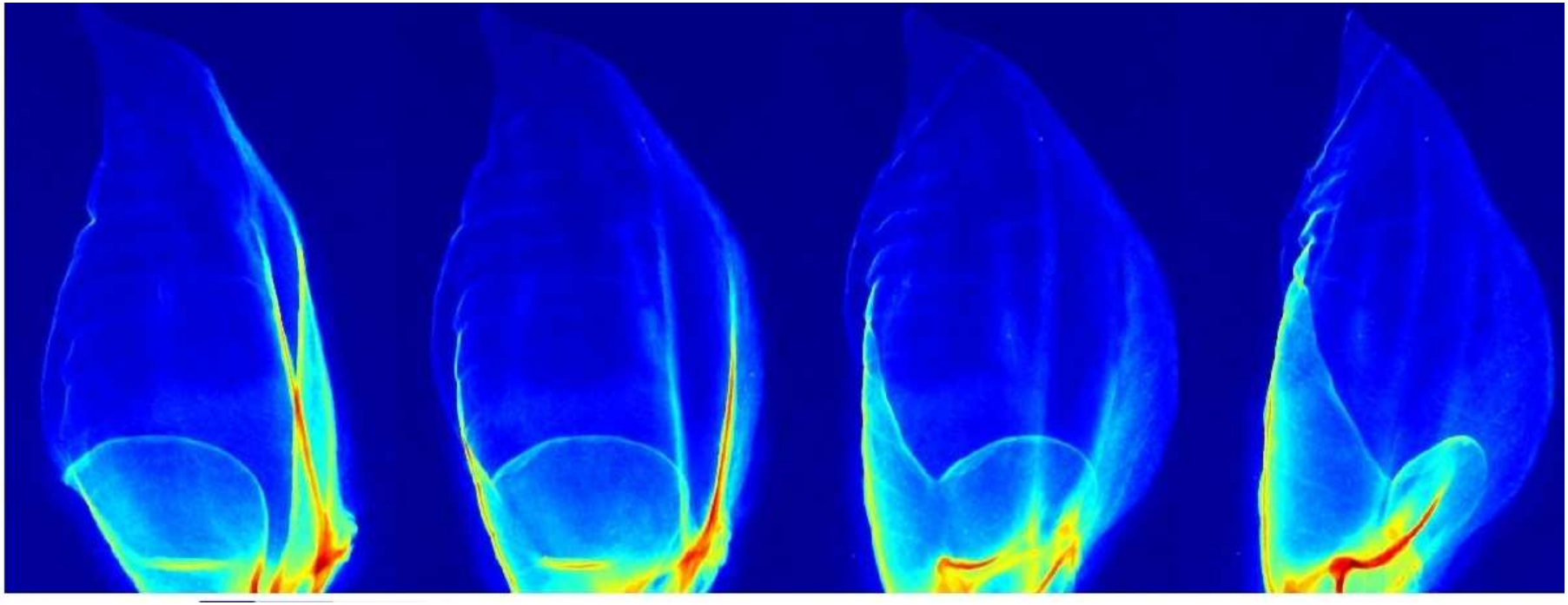
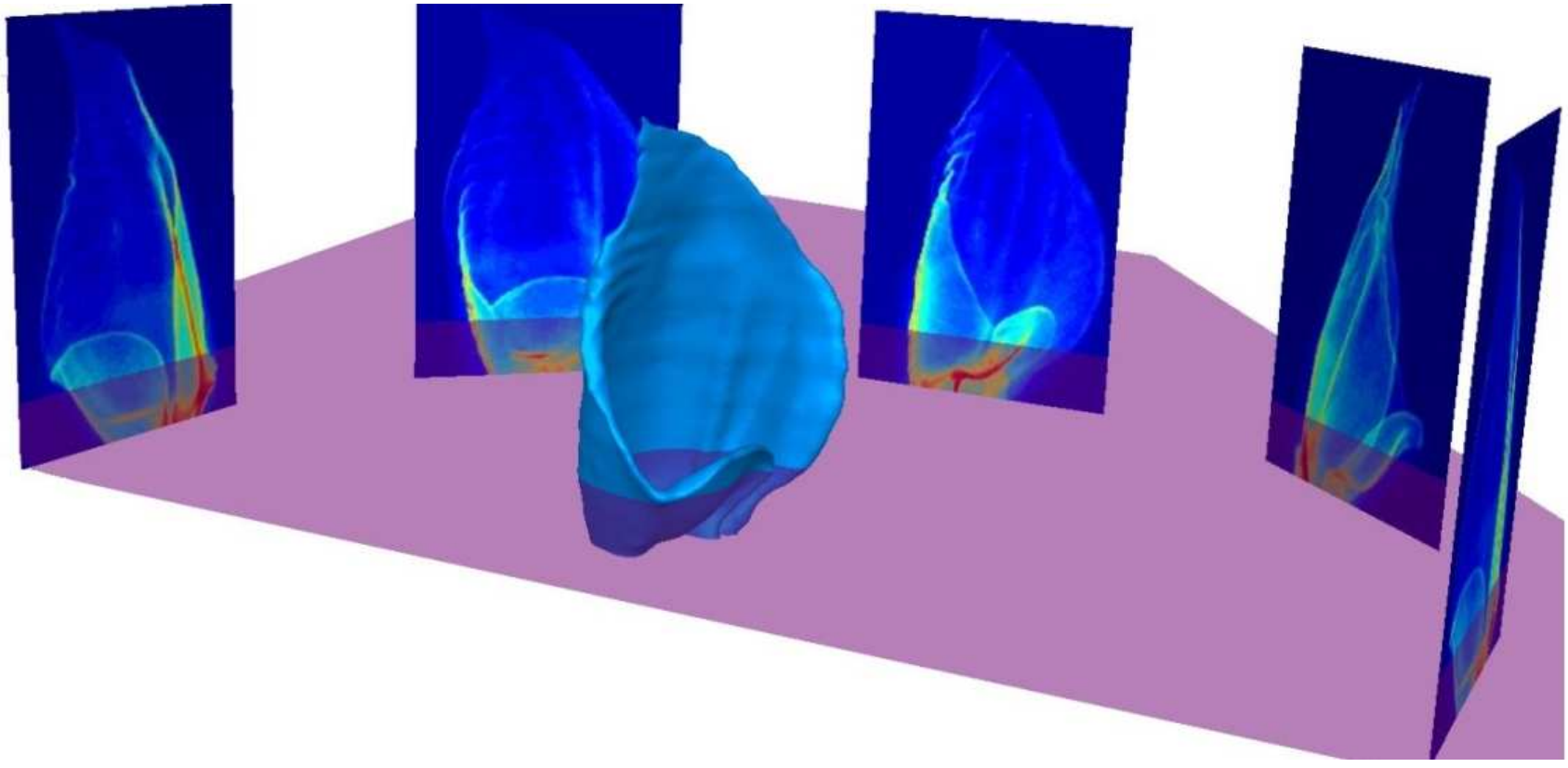


R. Müller, SDU, CIRCE project 2004

X-ray images from μ-CT machine

Shape — Current Technology



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Reconstruct shape using Feldkamp's method

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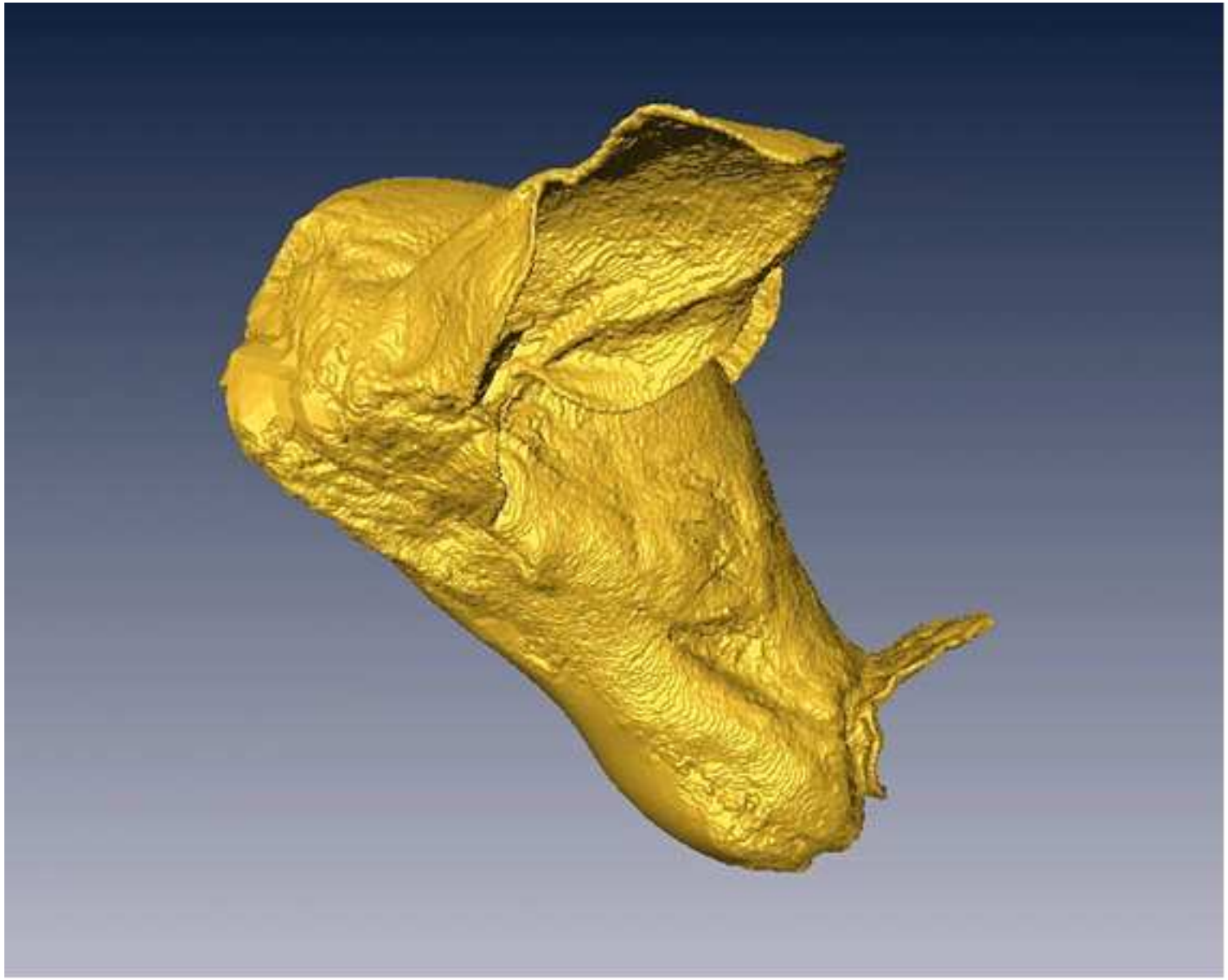

Shape — Problems & Challenges

Problems:

Challenges:

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- Destructive scanning

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Challenges:

- Non-destructive shape capture — dense stereo vision
- Dynamic shape capture — ear movements during flight
- Occlusion, motion, fur...

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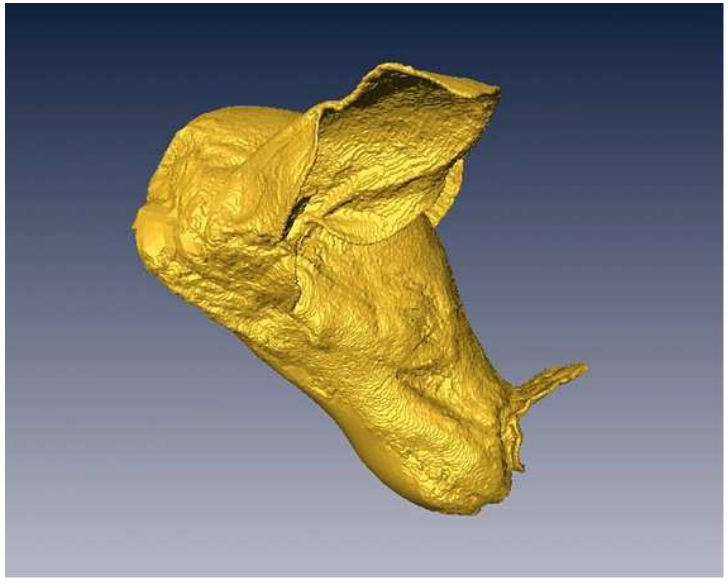

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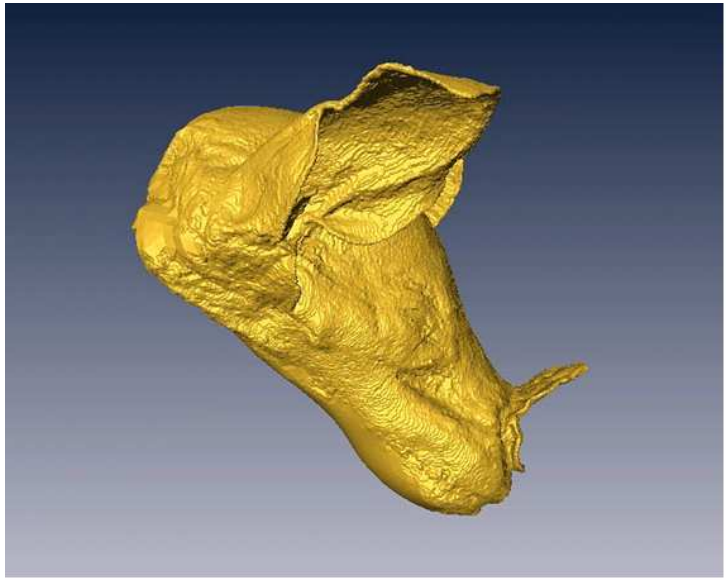
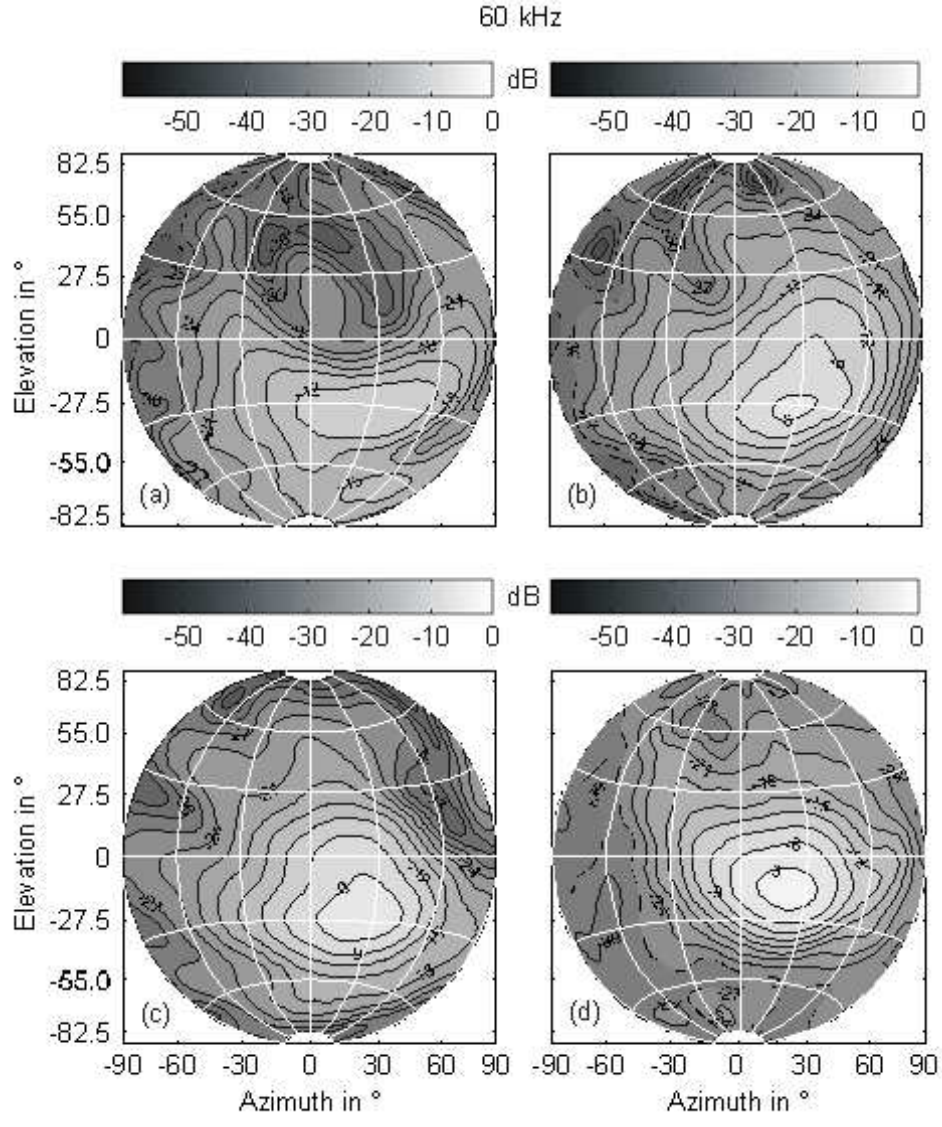


Use frequency domain acoustic BEM →



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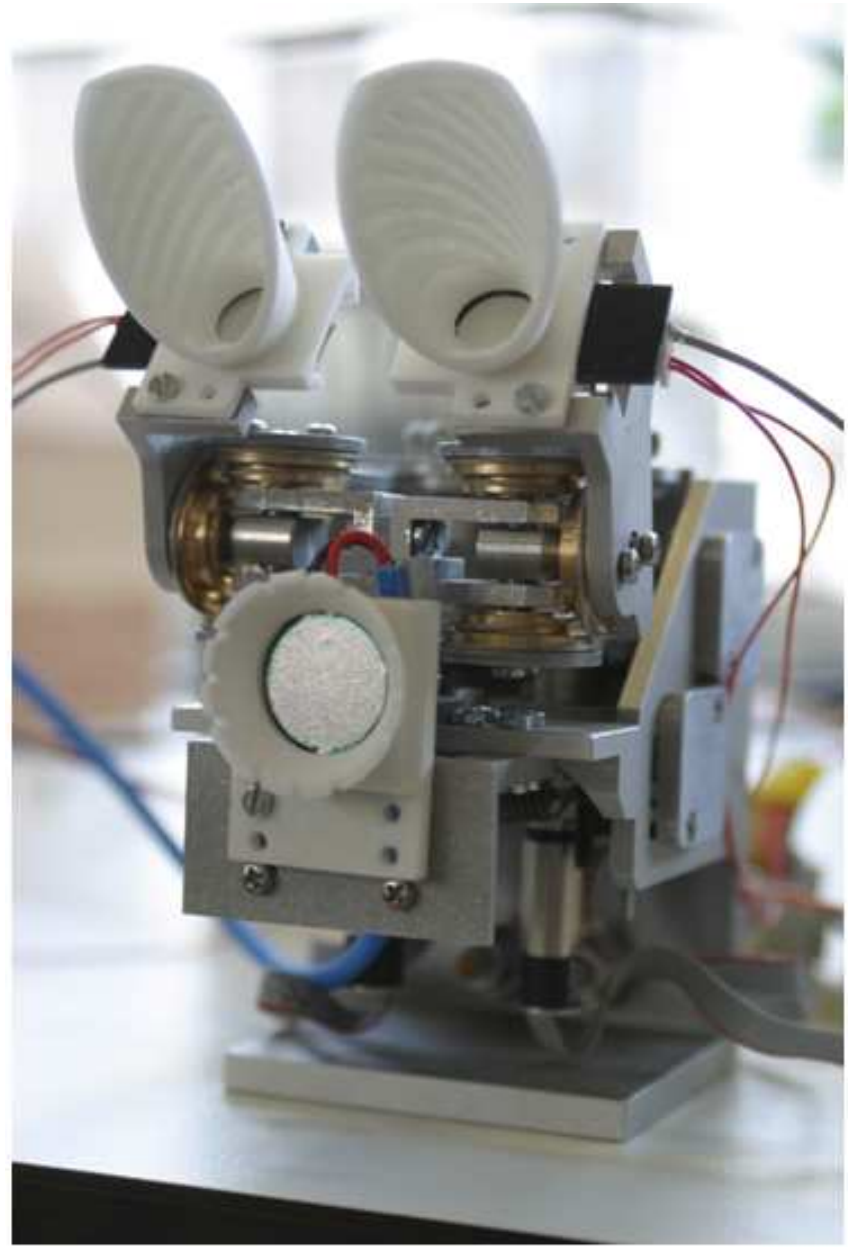
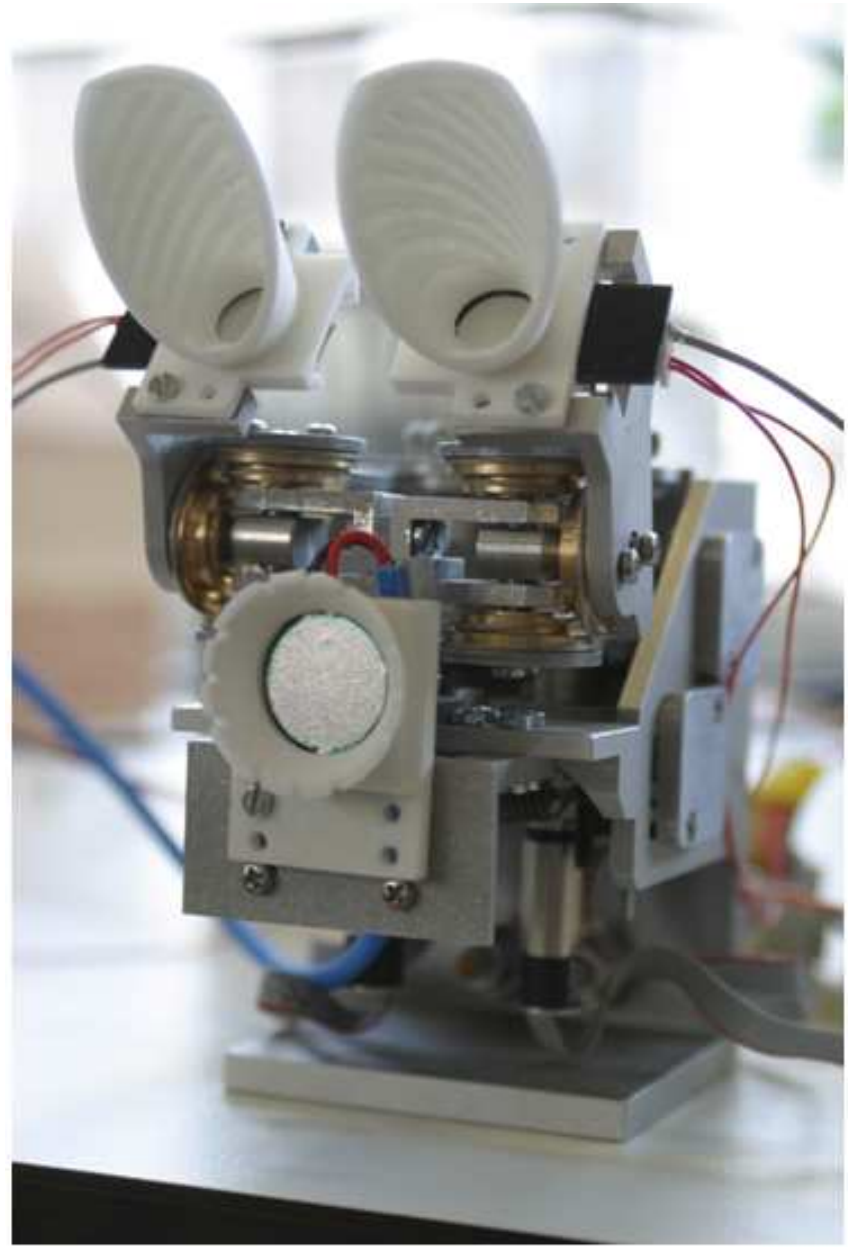


Systems — Current Technology

- 6 cm cube



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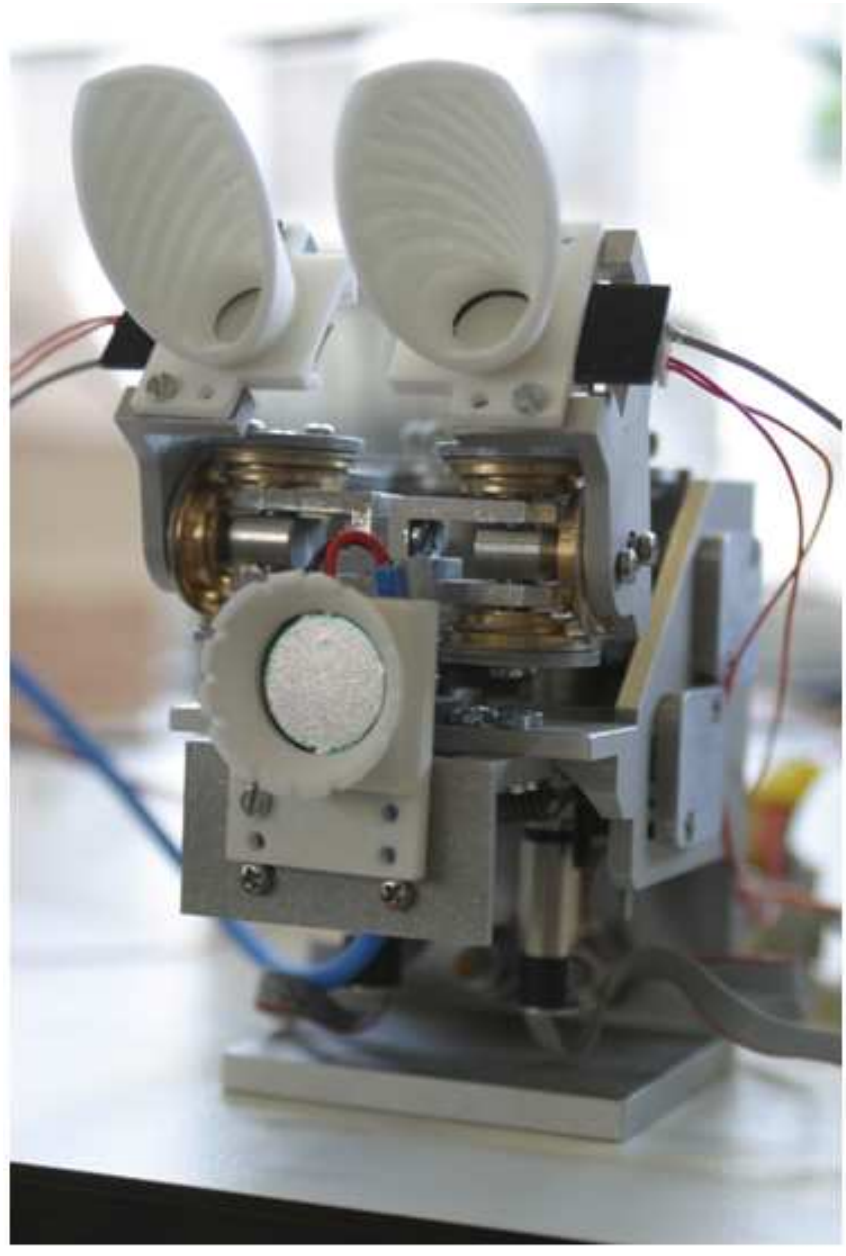

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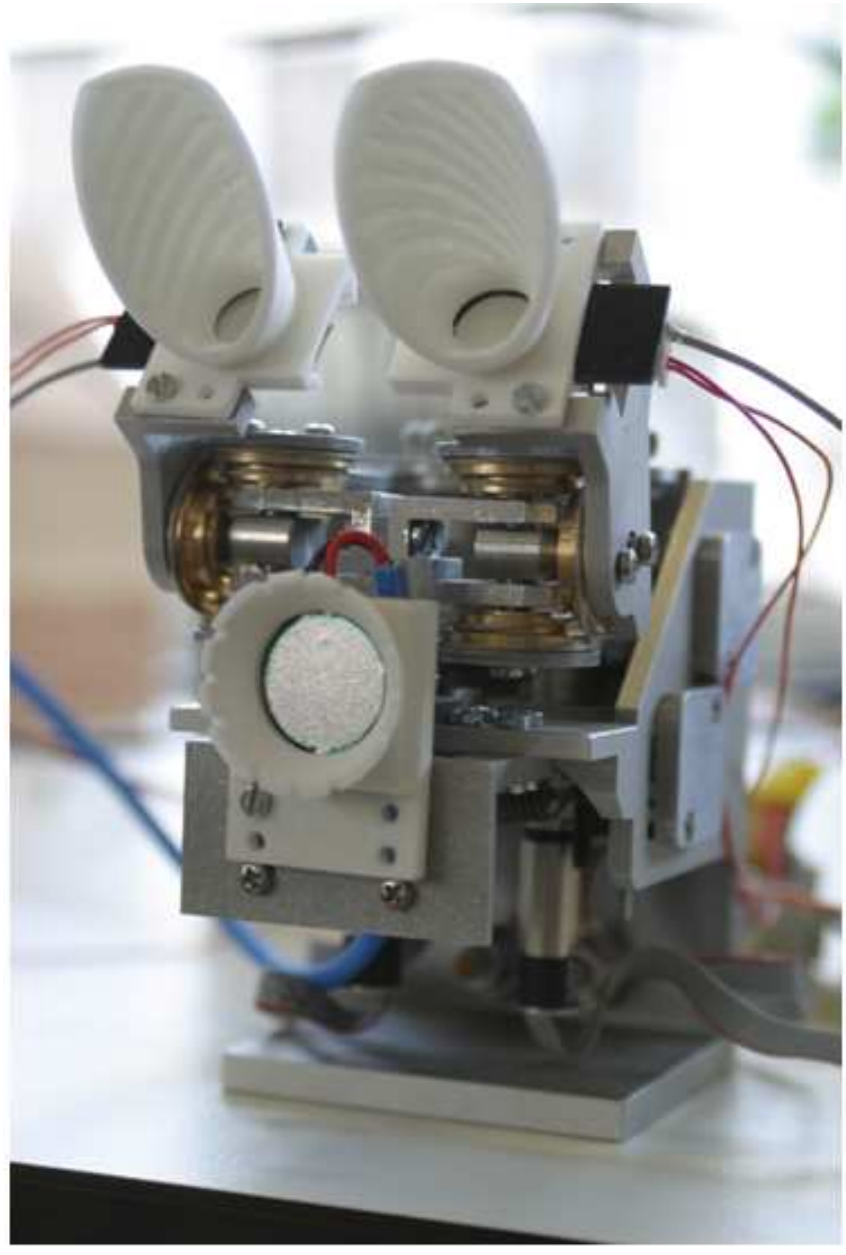

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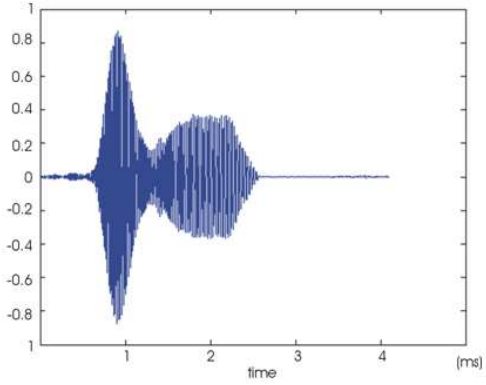

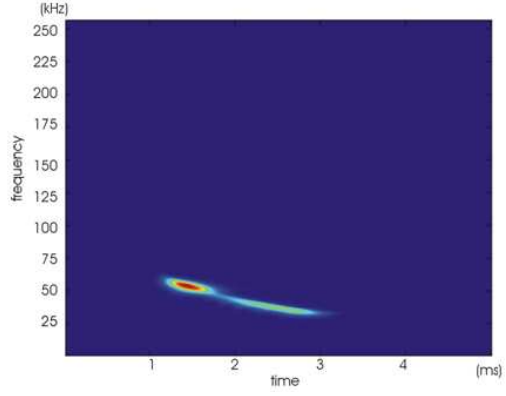

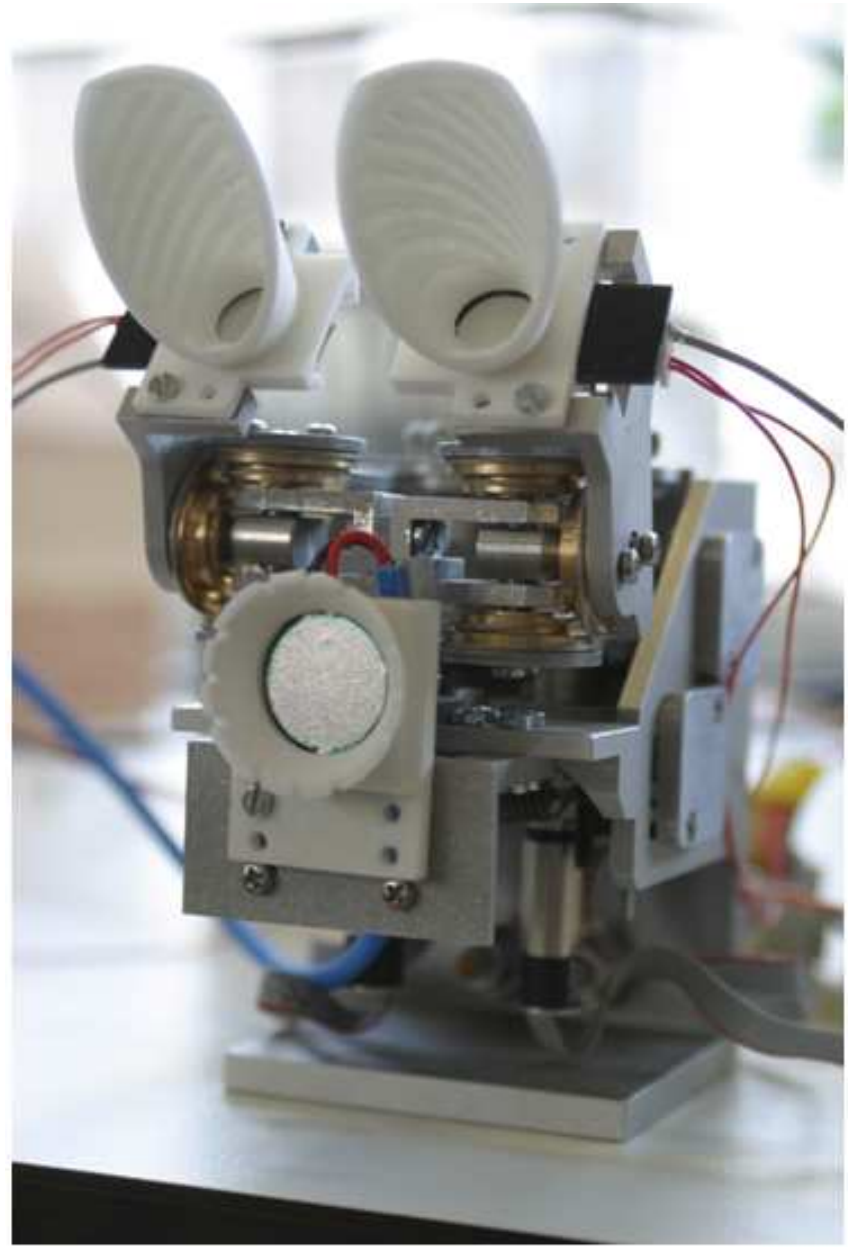

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- Reconstruct the bats' acoustic experiences
- Implement models based on this data set

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  Field biology; bat ethology; bat acoustics; access to BCI.