



Chiroptera-**I**nspired **R**obotic
CEphaloid

Period:

May 1, 2003 - April 30, 2004

Partners:

Universiteit Antwerpen

Universität Erlangen-Nürnberg

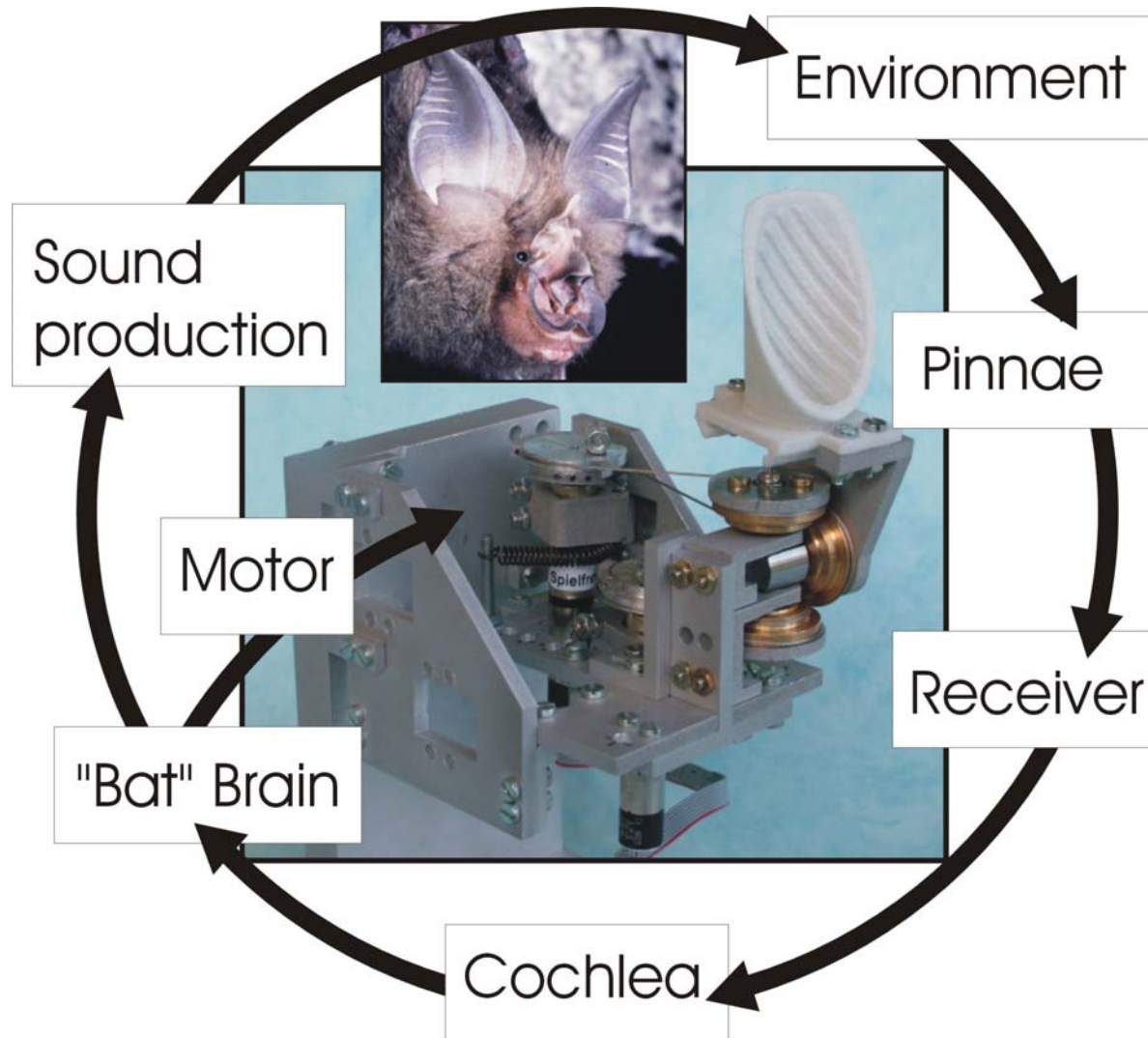
Katholieke Universiteit Leuven

Bath University

University of Edinburgh

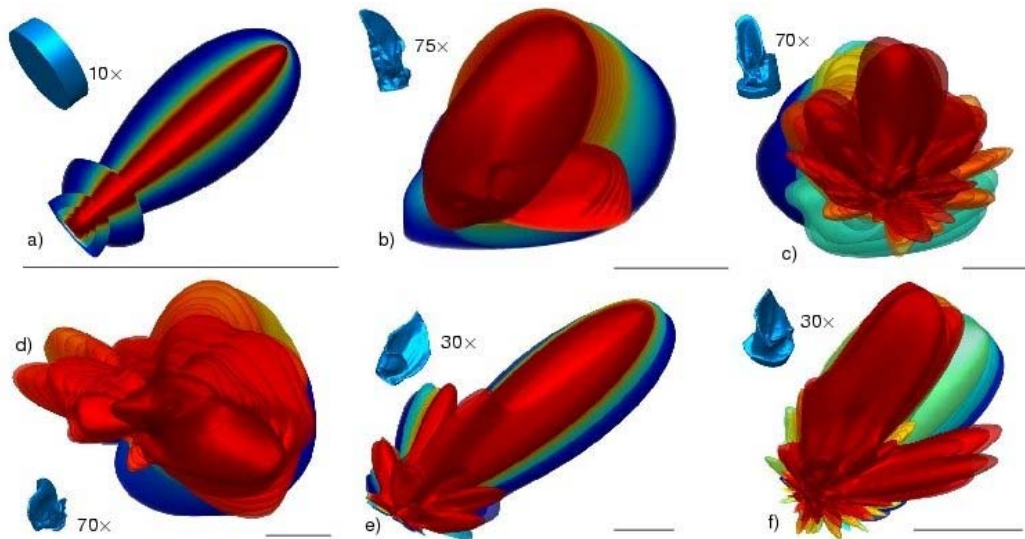
Syddansk Universitet (MIP)

Project work plan



Challenges: artificial pinnae

beamforming shapes to model the directivity of the bat's sonar system



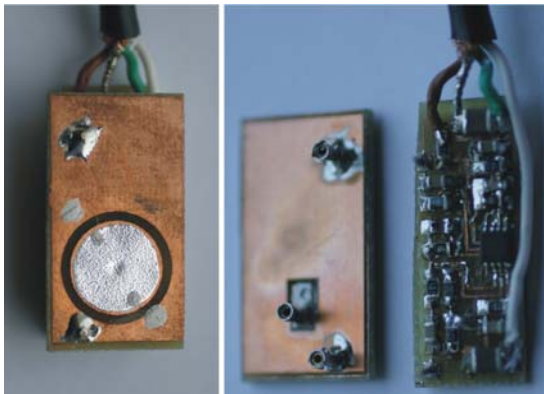
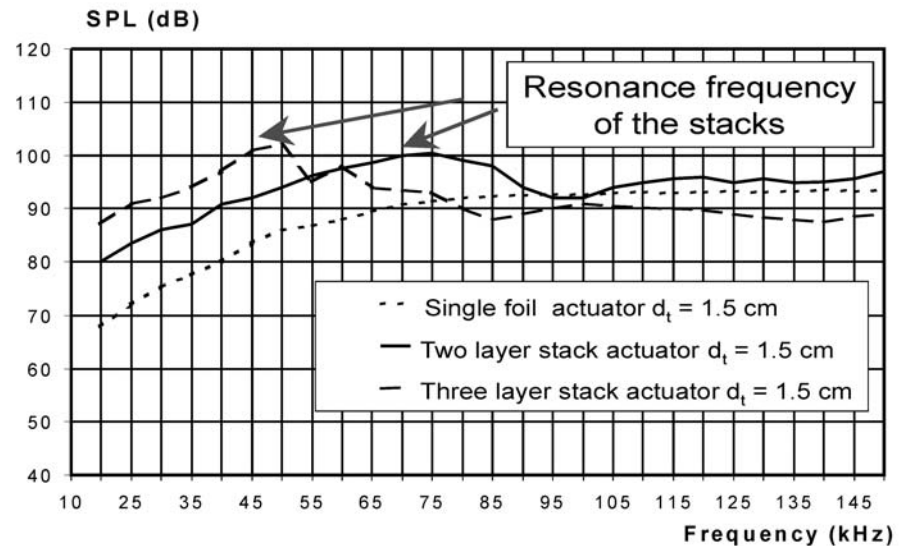
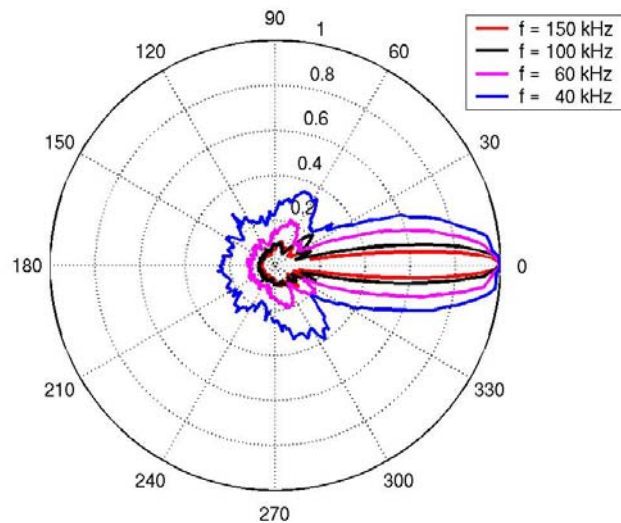
- automatic procedure for extracting pinna morphology and associated directivity: CT-scanner + 3D-shape extraction + 3D FEM-analysis
- directivity effects due to tragus

- automatic procedure for generating artificial pinnae (laser-sintering)
- measurements to validate simulation results on pinna prototypes



Challenges: generate/receive ultra-sound

EMFi-based transducers & efficient drivers/receivers



- different EMFi-based (ferroelectret) emitters were assembled and their sound output + directivity measured
- CIRCE drive amplifier: 800 V_{pp} with a bandwidth of 20 kHz in a 250 pF capacitive load
- different broadband and small-size (attached to pinnac) EMFi-based receivers were assembled and their sensitivity measured

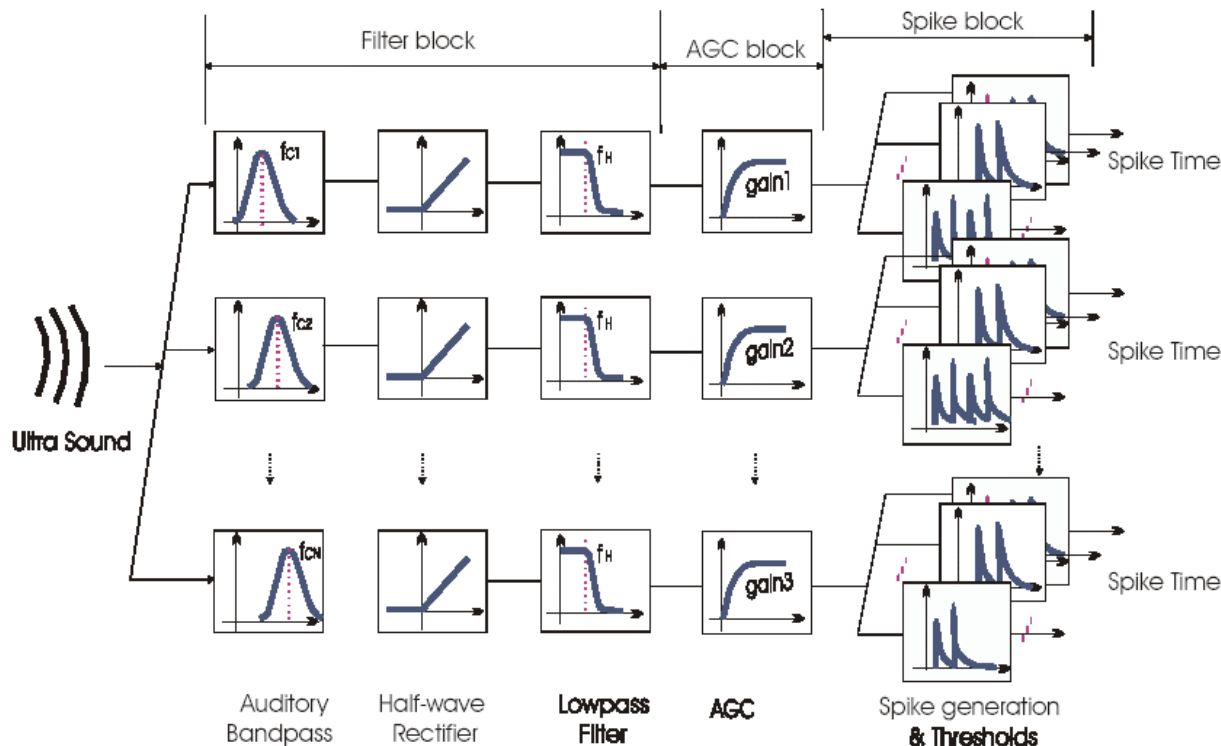
Challenges: neuromorphic processing

neuromimetic hardware for real-time signal processing

- the cochlear model reproduces functionally salient features of the bat's neural code, e.g., quantitatively similar, at the expense of model accuracy

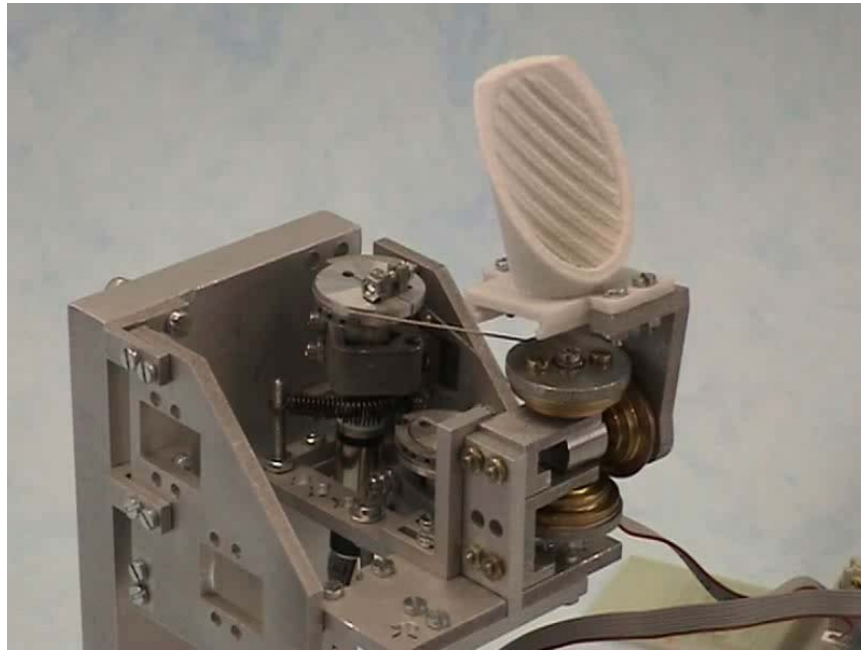
- the model is implemented in a single Xilinx VirtexII XC2V6000 FPGA chip running at 80MHz + PC interface (1MSamples/sec)

- the model consists of user-programmable bp-filters, hw-rectifiers, lp-filters, AGC and neural spike generation: 300 channels (->700) in the frequency range 20kHz-200kHz, 16 spiking neurons/channel (->30)



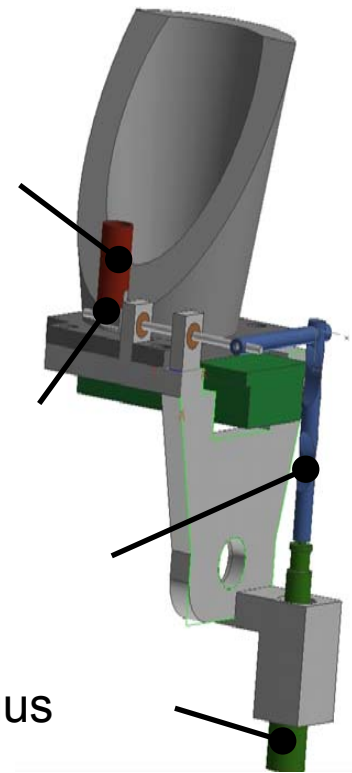
Challenges: actuated sonar-head

mechanical system for pinna movement & shape control



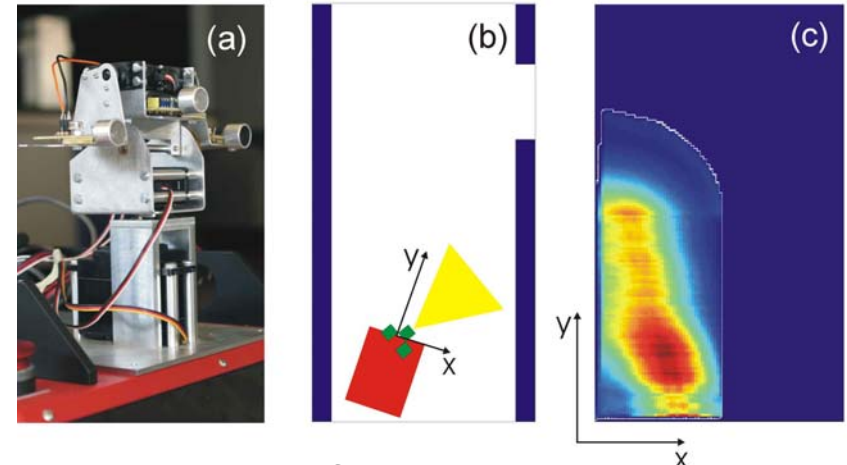
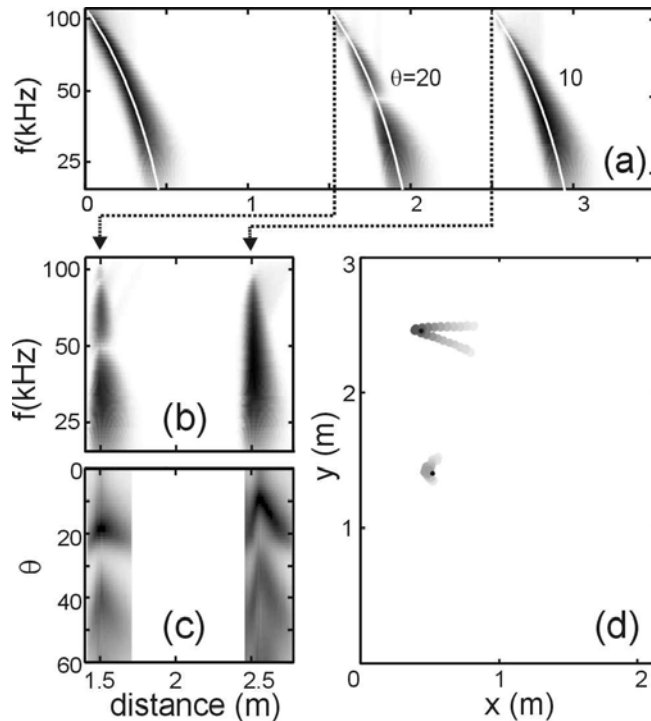
- pre-tensioned cable driven differential mechanism, rotating the mounted pinna ± 60 degrees with an accuracy of 0.1 degrees which exhibits practically no backlash

- a linear nanomotor based setup for the rotation of the tragus through a lever mechanism

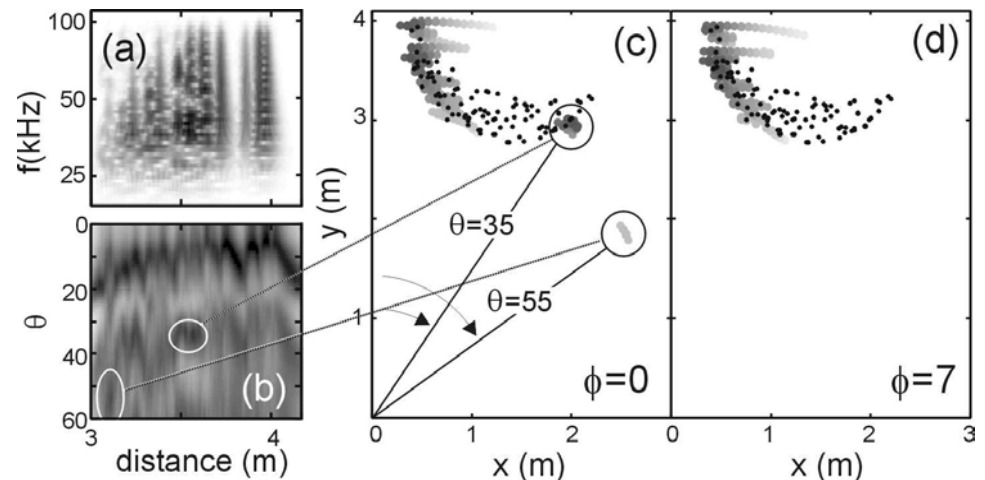


Challenges: realistic biosonar tasks

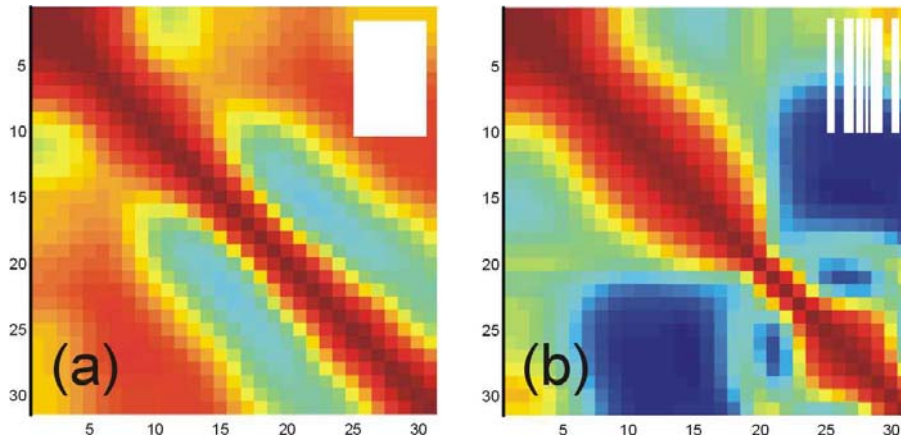
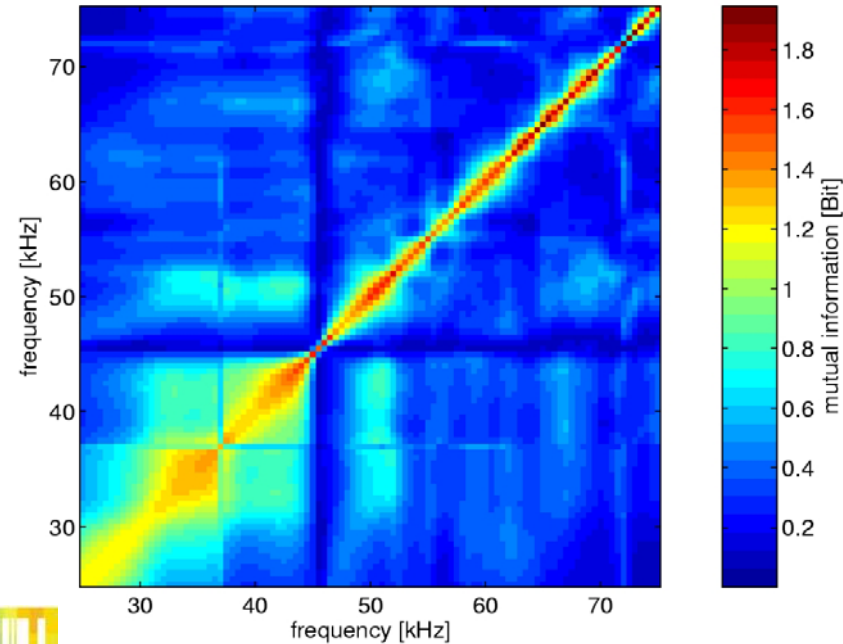
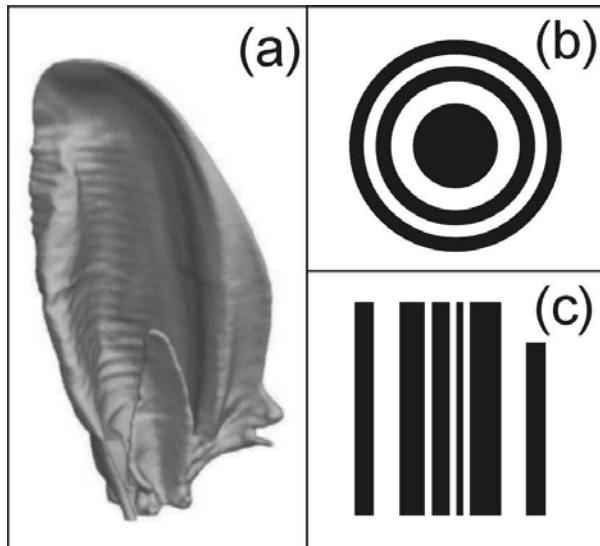
- experimental study of Doppler-based spatial mapping of the environment (“CF bats”)



- simulation study of spectrum-based spatial mapping of the environment (“FM bats”)



Challenges: realistic biosonar tasks



- simulation study of how outer ear shapes, transmitter/receiver shape relate to performance in biosonar tasks