Hypothesis
“An early model has been that she follows the simple rule ‘turn towards the ear more strongly stimulated’. We use the word ‘simple’ because a two eared robot programmed to obey this rule (if suitable noise were incorporated) could be made to track a sound source in a manner like the female” (Weber & Thorson, 1988)

Simple rule: ‘Turn toward the ear more strongly stimulated’
How is the stimulation compared?

- Tympanal vibration
- Neural response

Stronger stimulation produces higher firing rate and shorter latency to start firing.

Pressure difference receiver

Simple rule: ‘Turn toward the ear more strongly stimulated’

- Is the nearer ear more stimulated?

Other systems as source of hypothesis suggest:
- Amplitude difference?
- Time difference?
- Small size and brain of cricket make these difficult to use for localisation.

Suggested neural circuit

Simple rule: ‘Turn toward the ear more strongly stimulated’

- Turn how far, how often, to how much difference?
- What neural circuit is needed to compare firing rate or latency?
- What neural circuit is needed to select for intersyllable interval?

To understand a complex hypothesis it helps to implement it as a simulation using some technology.
Circuit compares latency of response

And thus will turn to ear more strongly stimulated

When tested on the robot, can choose between sounds, - preferring correct carrier frequency

Biorobotics: biological inspiration

E.g. Ayers et al, 1998: robot lobster for underwater mine clearance

“the set of behavioural acts that a lobster or lamprey utilises in searching for and identifying prey is exactly what an autonomous underwater robot needs to perform to find mines”

Biorobotics: robots used as models

E.g. Lambrinos, Möller et al, 1997 ‘Sahabot’ can directly calculate heading from polarisation pattern

“the goal of this approach is to develop an understanding of natural systems by building a robot that mimics some aspects of their sensory and nervous system and their behaviour”.

Summary

- ‘Biorobotics’ can mean two things:
  - A better robot is our target, and biology is the source of inspiration
  - Understanding biology is our target and robots are a source of ideas and a technology for testing hypotheses

So, should we try to build robots that are as similar as possible to the biological systems they are based on?

“the best material model of a cat is another, or preferably the same, cat”
Rosenblueth & Wiener (1945)

How might a model differ from its target?

Different dimensions of models

Recommended reading:
For details of the cricket robot described in the lecture see:
For detailed discussion of the use of robots as models and dimensions for describing models see:

Further references for biorobots:
Ayers et al (lobsters) see: www.neurotechnology.neu.edu
For work by Lambrinos et al (sahabot), and similar robots see: Robotics and Autonomous Systems, volume 30, issues 1-2 (Special Issue on Biomimetic Robots)
For an earlier description of the cricket robot, written for a general audience, see:
For recent work on the cricket robot see papers available from my website: homepages.inf.ed.ac.uk/bwebb/