Magneto-Inductive tracking of underground animals

Andrew Markham¹  Niki Trigoni¹  Stephen A. Ellwood²  David W. Macdonald²
1: Oxford University Computing Laboratory
2: Oxford University Wildlife Conservation Research Unit (WildCRU)

Problem:
- Some animals spend a large amount of their lives underground
- RF methods of tracking (GPS/VHF) do not work through soil
- Zoologists thus have an incomplete picture of animal behaviour

Approach:
- Electromagnetic (radio) waves cannot be used because soil has a high dielectric constant and hence attenuates electric fields
- Magnetic fields can pass through soil, water and air
- Animals fitted with custom designed MI tracking collars

System Design:

1: Generate magnetic fields
- Large coils on ground
- Time Multiplexed
- 125 kHz, 1300 bps

2: Sense
- Triaxial MI sensor
- Vector magnitude
- Rotationally invariant

3: Upload
- When animal emerges
- Zigbee 2.4 GHz
- Reliable bulk transfer

4: Localize
- Highly non-linear
- NLSE
- 40 cm accuracy

Summary:
- Ultra-low power (30 μW) localization
- Allows for tracking above and below ground and water
- Real world deployment on four badgers in Wytham Woods, Oxfordshire