Animal Wireless Body Area Networking

1. Multi-hop Animal Body Area Network

Applications
- Animal health monitoring
- Increased agricultural efficiency
- Resource allocation optimization

Communication Protocol Requirements
- Low power
- Energy efficiency
- Data Security
- Battery life

Communication Methodologies
- Narrowband RF Frequency
- 400 MHz band – MedRadio
- 900 MHz band – LoRa
- 2.4 GHz band – Bluetooth, ZigBee, WiFi
- Broadband Electro-Quasistatic (EQS) Intrabody Communication

2. Communication Methodologies and Protocols

- Narrowband RF protocols
- LoRa
- BLE
- Bluetooth
- ZigBee
- Wi-Fi

3. Comparison between different protocols

- Physical Layer Security
- RF WBAN
- Galvanic Intrabody Communication

4. Radio Frequency Experiments

- Experimental Procedure and Results
  - Performing a frequency sweep across various frequency bands and find the channel loss to create a channel model
  - Receiver Positions
  - Channel Loss Results
  - Receiver moved in circles along the body of cow shown in red
  - Path loss plots for 10 MHz across all positions on the cow body
  - Channel Modeling using FEM based simulations to characterize animal body as a communication channel across wide frequency band

5. Collaborative Intelligence

- Collaborative intelligence among multiple protocols
- Energy consumption minimized
- Higher energy efficiency resulting in increased lifetime of nodes

- Bluetooth, ZigBee – short range communication within herd
- Broadband EQS Galvanic Intrabody communication – in-body to out-of-body communication: Under active research

6. Conclusion and Future Work

- Low power, energy efficient and secure methods of communication are studied for animal WBAN applications
- Data transmission using RF based approaches performed for various frequency bands
- Preliminary channel modeling using FEM based simulations for basic understanding of channel loss in animal WBAN.
- Further experiments on RF approaches to develop an advanced channel model
- Development of science in the domain of Galvanic Intrabody EQS communication for in-body to out-of-body applications
- Development of galvanic intrabody EQS systems for in-vivo testing
- Study of collaborative intelligence around herd environment