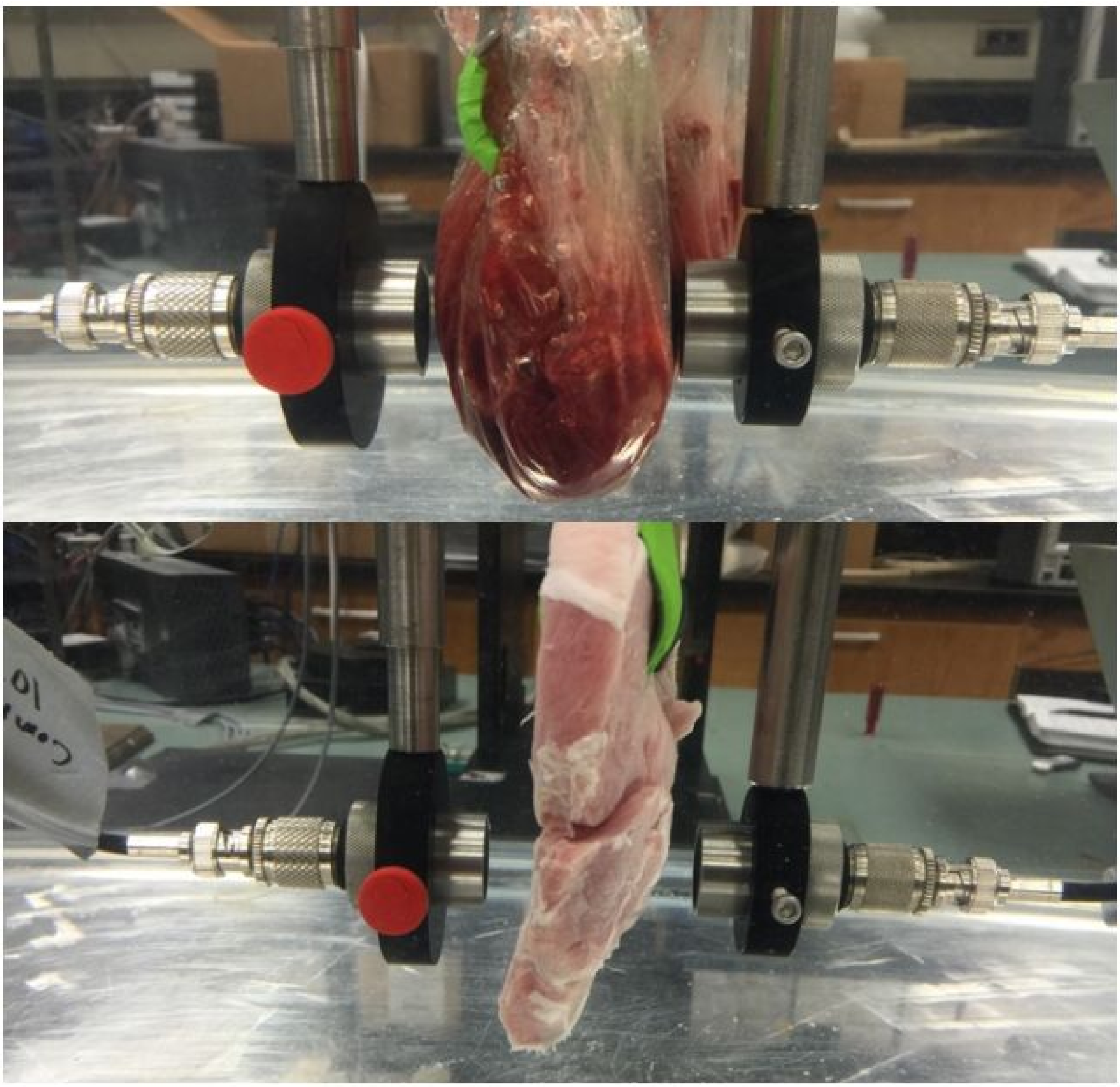
Transmission of digital communication signals through meat

April 16 2016, by Nancy Owano



Experimental setup using two 5-MHz transducers to send pass band QAM communication signals through beef liver (top) and pork loin (bottom). Credit: arXiv:1603.05269 [cs.IT]

Eye rubbing time—*New Scientist* had the headline "Wireless signal sent through meat fast enough to watch Netflix" and there were no typos. They meant what they said. *RT* explained further that "researchers have developed a wireless signal so strong that it could transmit high-definition video through your flesh."

One benefit from such a technique is that software updates could potentially be beamed directly to medical implants without the need to remove them surgically, said *New Scientist*. Aviva Rutkin in *New Scientist* talked about the human implication to their work as well. She said, "Your data rate is about to be beefed up," based on this effort by researchers, having fired "a wireless signal through slabs of pork and beef at speeds fast enough to transmit high-definition video."

Their paper describing the feat is "Mbps Experimental Acoustic Through-Tissue Communications: MEAT-COMMS," and the paper is on the arXiv. The authors are Andrew Singer, Michael Oelze and Anthony Podkowa, all from the University of Illinois at Urbana Champaign.

Their experiment involved transmission of digital communication signals through samples of pork tissue and beef liver. They got data rates of 20-30Mbps, demonstrating the possibility of real-time video-rate data transmission through tissue "for inbody ultrasonic communications with implanted medical devices."

Methods for communications through tissue have potential biomedical applications, "using the tremendous bandwidth available in commercial medical ultrasound transducers."

The authors made observations about the transmission of radio, used by implants, and how it presents some limitations.

"Radio waves do not travel well through the soft tissue in our bodies," said Rutkin. "Ramping up the power to improve the signal can be dangerous, as it heats up the tissue it passes through. "These limitations have stopped us developing medical implants that can send and receive useful amounts of wireless data," said Andrew Singer, at the University of Illinois at Urbana Champaign in the *New Scientist* report. So his team turned to ultrasound instead, said Rutkin.

The authors in their paper said, "Currently, most IMDs use radio-frequency (RF) electromagnetic waves to communicate through the body. The Federal Communications Commission (FCC) regulates the bandwidths that can be used for RF electromagnetic wave propagation available to IMDs."

Meanwhile, "the full potential for high speed communications using ultrasound has not been realized," they wrote. "In this paper, we provide results from ultrasonic communications experiments through tissue and validate the ability to achieve high data rates capable of real-time HD video streaming and remote control of tissue embedded devices."

The researchers are not walking away from this exploration any time soon. *RT* said the "next stage for the research team involves testing the approach with real medical implants or living tissue. Singer remains hopeful for the technology's future possibilities, which he thinks will enable doctors to update implant software without the need to surgically remove them."

More information: Mbps Experimental Acoustic Through-Tissue

Communications: MEAT-COMMS, arXiv:1603.05269 [cs.IT] arxiv.org/abs/1603.05269

Abstract

Methods for digital, phase-coherent acoustic communication date to at least the work of Stojanjovic, et al [20], and the added robustness afforded by improved phase tracking and compensation of Johnson, et al [21]. This work explores the use of such methods for communications through tissue for potential biomedical applications, using the tremendous bandwidth available in commercial medical ultrasound transducers. While long-range ocean acoustic experiments have been at rates of under 100kbps, typically on the order of 1- 10kbps, data rates in excess of 120Mb/s have been achieved over cm-scale distances in ultrasonic testbeds [19]. This paper describes experimental transmission of digital communication signals through samples of real pork tissue and beef liver, achieving data rates of 20-30Mbps, demonstrating the possibility of real-time video-rate data transmission through tissue for inbody ultrasonic communications with implanted medical devices.