

BIOENGINEERING AT UCR AND SOME RECENT WORK IN IMAGING AND BIOMOLECULAR ENGINEERING



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ABSTRACT

Despite being a recognized discipline for more than 4 decades, bioengineering (or biomedical engineering) is still evolving, expanding, and maturing, and it is presented with both opportunities and challenges. Success in bioengineering hinges on taking advantage of the opportunities and addressing the challenges. UCR bioengineering program is built and developed based on the following guiding principles,

- 1) Interdisciplinary, with seamless integration of engineering and biomedicine;
- 2) Multiscale, ranging from molecules, to cells, to systems, to organs and diseases;
- 3) Multifaceted, encompassing basic, engineering, and translational research;
- 4) Cross-cutting, with research areas that are complementary and inter-related/synergistic.

In the first part of my talk, I will describe the development and evolution of our department, and highlight some of our research and educational activities.

In the second half of my talk, I will describe some work in my own lab on MRI of neurodegeneration and genetic approaches for molecular imaging and cancer therapy. MRI is a versatile imaging technique capable of visualizing not only anatomy but also biomarkers for a variety of diseases. With neuromelanin sensitive MRI and iron sensitive MRI, we identified several biomarkers for the early detection of Parkinson's disease. Furthermore, with diffusion tensor imaging and neuromelanin imaging, we were able to identify aging-related changes in the locus coeruleus and its structural connections. Magnetotactic bacteria synthesize intracellular magnetite nanoparticles known as magnetosomes. Although the production of magnetosomes is achieved by the coordinated effects of multiple genes, we targeted 2 genes in our work. The first is magA, an iron transporter gene, and the second is mms6, a gene for an iron nucleation scaffold. We have expressed these two genes in mammalian cells individually and demonstrated that each expression led to the production of iron oxide nanoparticles, generating detectable MRI contrast in relevant cells. Recently, we co-expressed them in the same cell line and revealed that the dual expression led to enhanced production of nanoparticles and hence higher MRI contrast, demonstrating their potential as an MRI reporter. Furthermore, the gene-derived production of magnetic nanoparticles also allowed targeted killing of cancer cells with alternating magnetic field. Overall, work demonstrate an effective theranostic approach.

BIO

Xiaoping Hu obtained his B.S in Physics from the University of Science and Technology of China in 1982 and his Ph.D. in medical physics in 1988 from the University of Chicago. From 1990 to 2002, he was a faculty member at the University of Minnesota where he became a full professor in 1998. In 2002-2016, he was Professor and Georgia Research Alliance Eminent Scholar in Imaging in the Wallace H. Coulter joint department of biomedical engineering at Georgia Institute of Technology and Emory University. In July 2016, Dr. Hu joined UC Riverside as professor and chair of bioengineering and director of the center for advanced neuroimaging. Dr. Hu has worked on the development and biomedical application of magnetic resonance imaging, with an emphasis on the brain, for almost 4 decades. He has authored or co-authored 335 peer-reviewed journal articles, with a total of 37,000+ citations and an h-index of 105. He is currently on the editorial board of Brain Connectivity and is an associate editor of Magnetic Resonance in Medicine. He is a fellow of the International Society for Magnetic Resonance in Medicine, a fellow of IEEE, a fellow of American Association for the Advancement of Sciences, a fellow of American Institute of Medical and Biological Engineering, and a fellow of the International Academy of Medical and Biological Engineers. He was named Reza Abbaschian Chair in July, 2023 and promoted to distinguished professor in July, 2024.