Principal Investigator: Dr. Hao Xu

Title: Teledoc: A Smart Radar-assisted Telehealth Monitoring System

Abstract:

This project aims to investigate a low-cost, portable, high-quality telehealth monitoring system that can 1) provide NASA a novel life support system to mitigate the highest risks to human health and performance to enable safe, reliable, and productive human space exploration; and 2) deliver a promising solution that can enhance civilian access to public healthcare resources in emergencies, like pandemics or inclement weather (Fig. 1). Telemedicine is a key component of medical care on the International Space Station (ISS). In the early 1970s, NASA partnered with the Papago (now Tohono O'odham) Nation of southern Arizona to establish the Space Technology Applied to the Rural Papago Advanced Health Care (STARPAHC) project [1]. In recent decades, with NASA's sustained presence in space through programs like the ISS as well as potential travel to an asteroid or other solar body, telemedicine has remained an important priority for NASA. In January 2020, NASA successfully used a telehealth program to monitor the health of an astronaut who developed a blood clot during a six-month mission at the ISS [2]. Meanwhile, since late 2019, the highly infectious coronavirus has greatly stressed healthcare systems and entire nations around the globe. Telemedicine has become one of the most powerful tools to help with potential overcrowding and healthcare resource scarcity. Thus, the U.S. Department of Health & Human Services has encouraged healthcare providers to adopt and use telehealth as a way to safely provide care to patients in appropriate situations [3]. To deliver affordable, high-quality telemedicine to either astronauts or civilians, effective telehealth monitoring techniques are critical.

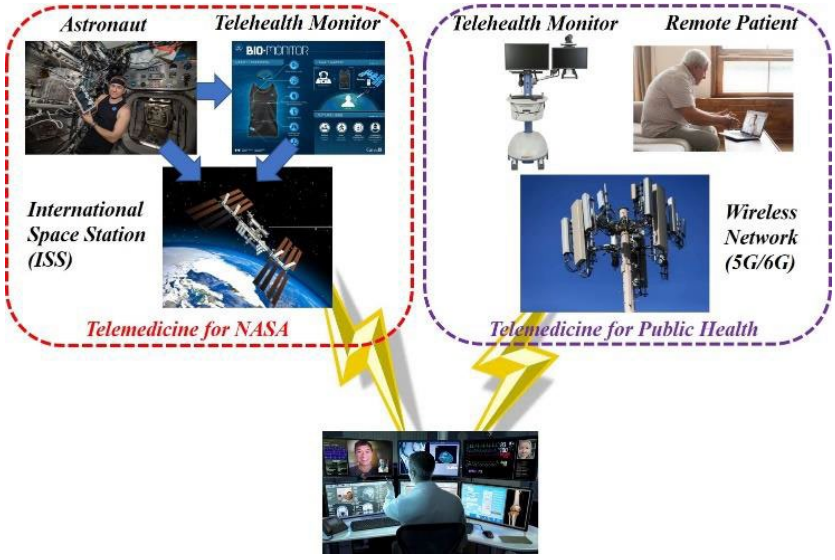

Fig. 1. Telemedicine for NASA and public health.

One major challenge is how to

accurately measure and efficiently analyze human health through raw data collected by biometric sensors. Many federal agencies and research institutions (NASA [4], AFRL [5], DARPA [6], Lawrence Berkeley National Lab [7]) are interested in related research, but there is still a gap between expectation and existing telehealth monitoring systems due to the inconvenience of wearable sensors and their limited adaptability to real-time uncertain environments. To address this gap, we propose a novel low-cost, contact-free, high-quality, radar-assisted telehealth monitoring system with artificial intelligence (AI)-on-the-chip. We will 1) develop a novel micro-Doppler radar that can effectively monitor human vital signs (cardiopulmonary activities); 2) design a novel hybrid deep reinforcement learning-based radar signal processing algorithm that can deliver real-time human health condition assessment using monitored vital signs; 3) develop a smart telehealth monitoring platform with AI-on-the-chip that implements the developed radar system and hybrid deep learning-based signal processing algorithm. We will conduct real-time experiments in different environments to validate the effectiveness and practicality of the

Fig. 1. Telemedicine for NASA and public health.

developed scheme. This work will also provide undergraduate and graduate students broad handson experience in electromagnetics, telemedicine, and AI.