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Description of the Needs and Problems our Proposal Addresses

Radio-frequency (RF) and microwave antennas are mission-critical in many areas, including first-responder communications, physics research, and radar for aerospace engineering and defense. All of these sectors play a role in shaping the economy of Southern California, and RF design innovation will be important for the growth of 5G mobile communications. Innovations in this sector have the potential to improve the lives of millions of people. According to a recent report entitled “The Changing Face of Aerospace in Southern California,” the aerospace industry alone accounts for 90,000 employees and 14% of the aerospace industry in the USA. These numbers grow above 100,000 if NASA facilities are included. Growth has been concentrated in the space vehicle and guided missile sectors. The average pay for these jobs is approximately double the national average. In the near future, the workforce for these technological sectors will need replenishment and diversification.

The design and fabrication of RF antennas has traditionally been limited by two factors. First, the design and simulation of RF elements is usually accomplished using expensive, proprietary software. The software calculates how much energy can be radiated efficiently by a given design, in order to form the signal. The geometry of the design largely determines the efficiency and bandwidth of the system. Creating novel and innovative geometries requires intuition and practice with this expensive software. Second, the fabrication of complex prototypes is limited by the ability to machine conductive structures with lengths on the order of 1 cm – 10 cm efficiently on a mass scale. Prof. Jordan Hanson in our Dept. of Physics and Astronomy has developed a process by which novel RF designs can be created and fabricated that solve both problems. By utilizing open-source computational electromagnetism (CEM) software, and 3D printing the designs using conductive filament, more efficient production of designs is achieved.

As a small liberal arts school with a diverse and talented student body and faculty, Whittier College is an ideal place to offer research scholarships in RF design and fabrication. According to our institutional research, 40% of our students are first-generation, and 70% of our students are people of color. Our institutional character is defined by offering access to higher education and research opportunities to under-served populations. This research represents an opportunity to introduce these students to technological research that will open for them new professional pathways. Our students need engaging software development and hardware experiences applicable to the engineering sectors of Southern California. Whittier College students have already become involved with this research, which has led to peer-reviewed scientific publications. Now it is time to build upon these outcomes, by solidifying and enhancing the size and scope of our students’ experiences on this front. Whittier College students are accustomed to learning from each other in hands-on activities within STEM courses. Thus, our program will meet this need by building peer-learning teams that can learn new content, perform the research, and share the results as they are integrated into the STEM curriculum. Professor Hanson teaches several courses idea for research integration into the course curricula. Future Whittier College students will therefore be inspired by our progress, thereby facilitating future recruitment into the program.