AI & Robotics

Prof. R. Prasanth Kumar

Dept. of MAE

KID: 20200217

I am working in the general area of mobile robotics, with emphasis on legged robotics. Robots that move on two or four or six legs are particularly useful in traversing rough terrains where wheeled mobile robots face difficulties. Biped/humanoid robots are preferred in civilian environments due to their adaptability to tools/structures used by humans. Bipedal robots are much more unstable compared to quadruped and hexapod robots. My current research focuses on the walking stability of biped robots for extreme cases of walking such as taking long steps, for instance, over ditches. We have successfully generated stable joint trajectories for large steps using genetic algorithms offline and using mechanics and control based algorithms in real-time. Dynamic walking with double support phase under actuator faults is another research area we are pursuing. Further, I also work on navigation and controller development for autonomous passenger drone.

Snippet of AI Research from Saidhiraj Amuru

Dr. Saidhiraj Amuru

Dept. of EE

KID: 20200218

Every technology usually takes around 10-15 years from the conception phase to research and ideation phase and finally to the implementation phase. 5G was initially conceived when 4G LTE was being developed and networks were starting to be deployed around the world. 5G is now being developed in most places except for small pockets of deployments around the world. Going by the current trends of technology development now is the time to think about 6G. 6G is touted to be the technology that connects humans and machines in a more deep-rooted fashion than 5G. One question that arises is what is 6G going to be? 6G can comprise of many technical innovations – terahertz communication, intelligent surfaces, artificial and machine learning equipped wireless networks among others.

My research in 6G focuses on the applications of machine learning for wireless communications. We study ML-enabled methods to make wireless networks intelligent that cater to the ever-increasing demands of connectivity and data deluge. Some of the problems we work on include downlink precoding for multi-user connectivity in a decentralized broadcast network, addressing the performance loss due to delayed or stale feedback by employing prediction-based algorithms, massive user scheduling in practical cellular networks where each user experiences different channel conditions, and has varied traffic requirements, indoor and outdoor localization using channel state measurements, human activity detection using WiFi measurements, physical layer security among others.

Continued…

In each of the research problems we study, we first understand the theoretical underpinnings of each problem using the vast wireless communications literature available from over 70 years of research in these areas. Later, we employ various tools from machine learning, spanning from supervised, unsupervised, self-supervised and reinforcement learning techniques, to achieve improved performance at their respective tasks that were previously possible only in select settings. While not stopping at performance, we also delve deeper to understand why certain deep learning algorithms tend to perform well while others do not. For example, in this regard, we studied what kind of neural networks must be used to perform well at a certain task under different kinds of wireless channel models such as AWGN, Rayleigh fading, or channels with memory. Most of the problems we work on require the students to have good knowledge of wireless communication fundamentals as well as hands-on experience with machine learning tools.

At IITH, I introduced a course on machine learning applications for wireless communications, the first such course in academia across the world. As part of this course, we learn how modern machine learning techniques are applied to solve a variety of problems in wireless communications. Some of the projects done by students in this course have resulted in publications in prestigious venues. We are constantly looking for motivated students, both undergraduate and graduate-level to contribute to this upcoming field of research and make fundamental contributions.

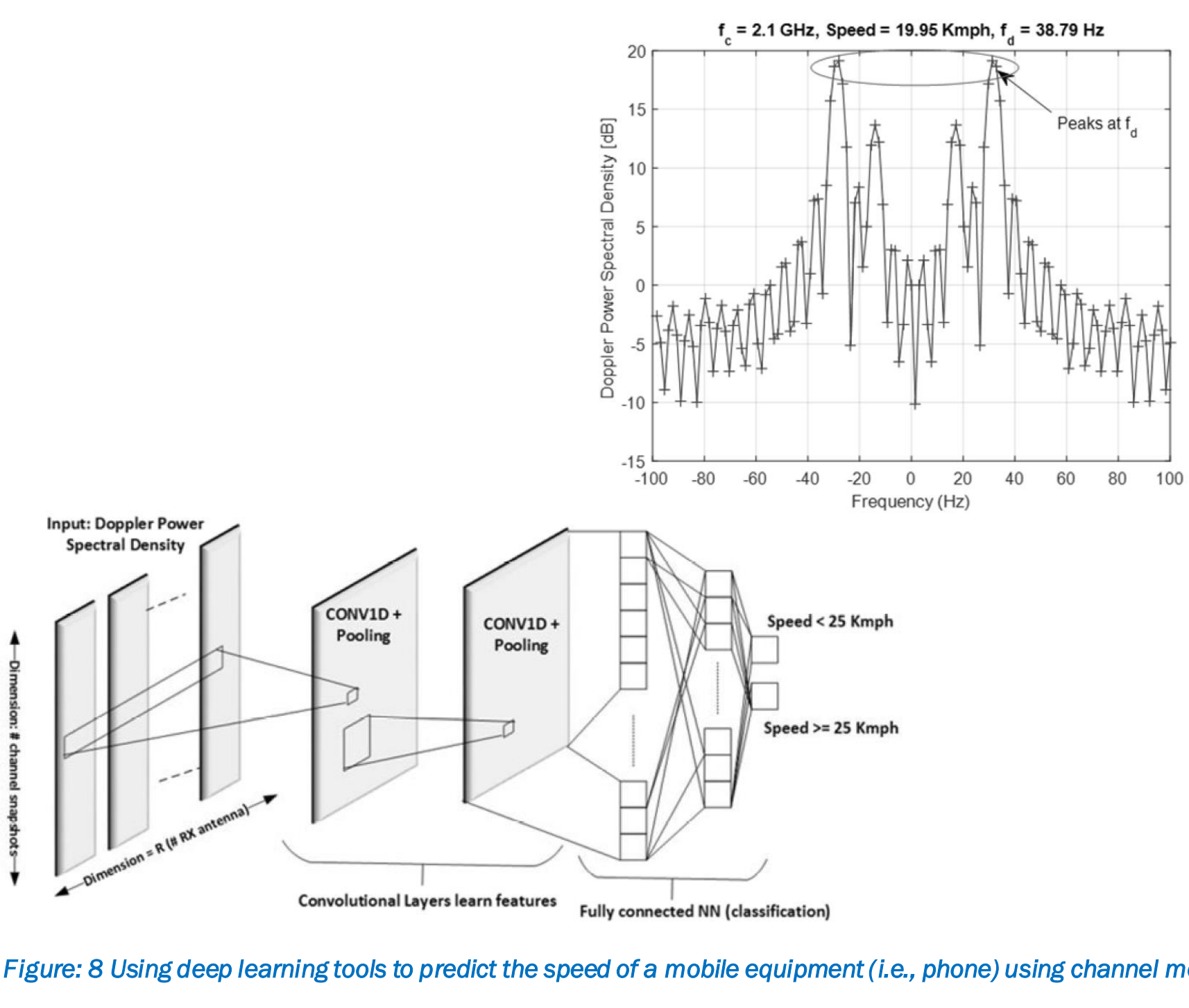

Figure: 8 Using deep learning tools to predict the speed of a mobile equipment (i.e., phone) using channel measurements