The University of Texas at TYLER

IARIA

Special Track

QuVA 2021: Quality of Experience (QoE) Driven VR/AR Multimedia System Design

Chair
Jounsup Park, University of Texas at Tyler, USA
jpark@uttyler.edu

QuVA 2021

- Virtual Reality (VR) and Augmented Reality (AR) technology has a potential to be the next major multimedia contents because VR /AR can provide immersive experience to the users. The VR/AR systems must be designed to provide high quality multimedia exp erience to the users depending on their applications. We are calling for contributions on the VR/AR multimedia system designs con sidering user experience.

- VR/AR systems consist of many design components, such as sensors, networks, audio, and display devices. The sensors are necess ary for implementing VR/AR services. Sensors are not only used for generating VR/AR contents, but also for the acquisition of vie wer's position. Networking necessary to deliver high quality VR/AR data. Audio and display devices directly affect the user experi ences. It is necessary to optimize the VR/AR system considering all these design components to provide high quality VR/AR servic es.

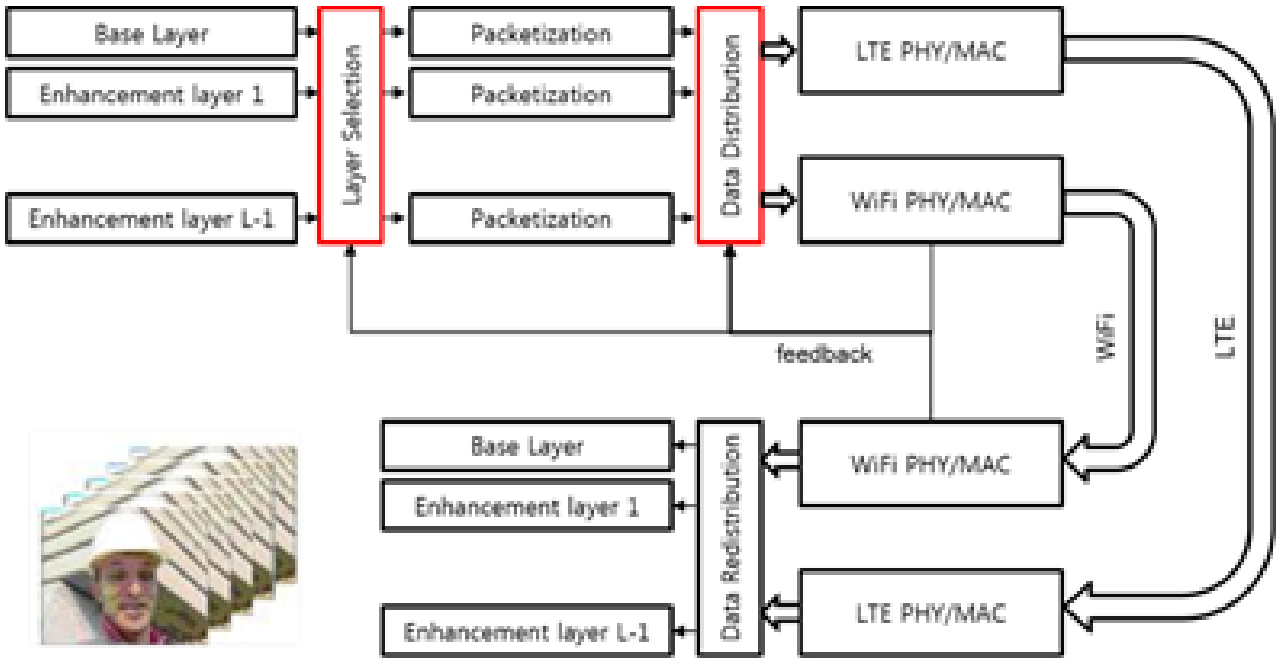
- Topics include, but not limited to
  - Virtual Reality (VR) and Augmented Reality (AR) systems
  - Video streaming systems and rate control algorithms
  - Video communication system design
  - 3D point cloud streaming
  - Low latency networking protocol
  - VR/AR Quality of Experience metrics
  - Acoustic signal processing
  - mmWave Radar signal processing
  - Lidar/Radar imaging

Presenters

- Jounsup Park, Scalable Video Streaming over Multi-RAT Network, jpark@uttyler.edu
- Seungmo Kim, On Security and Energy Efficiency in Underwater Wireless Sensor Networks for Maritime Border Surveillance, seungmokim@georgiasouthern.edu
- Seungmo Kim, Simulations for Stochastic Geometry on the Performance of V2X Communic ations in Rural Macrocell Environment, seungmokim@georgiasouthern.edu
- Thomas Moon, High Resolution mmWave Radar by Radar Fusion and Sparse SAR, tmoon@illinois.edu

Scalable Video Streaming over Multi-RAT Network

- Multi-RAT: LTE + WiFi
- SVC: Scalable Video Coding → rate adaptation
- Optimal Rate Adaptation and Packet Distribution algorithm is introduced



SVC Video Streaming System

On Security and Energy Efficiency in Underwater Wireless Sensor Networks for Maritime Border Surveillance

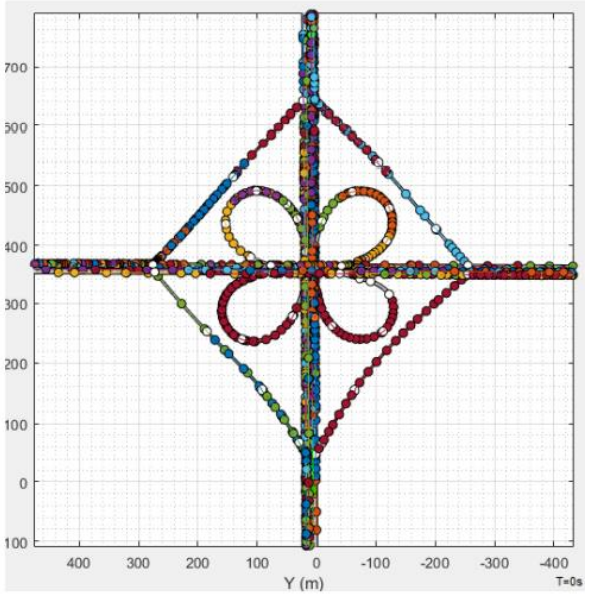
- Underwater wireless sensor networks (UWSNs) based on acoustic communications attract interest as an enabling technology of maritime border surveillance. However, due to differences in environments, many of the techniques used in typical terrestrial wireless communications are not directly applicable to UWSNs. Of the challenges, designing a secured and energy-efficient UWSN takes the greatest significance for application to maritime surveillance applications. To provide an overview on the UWSN technology, this paper

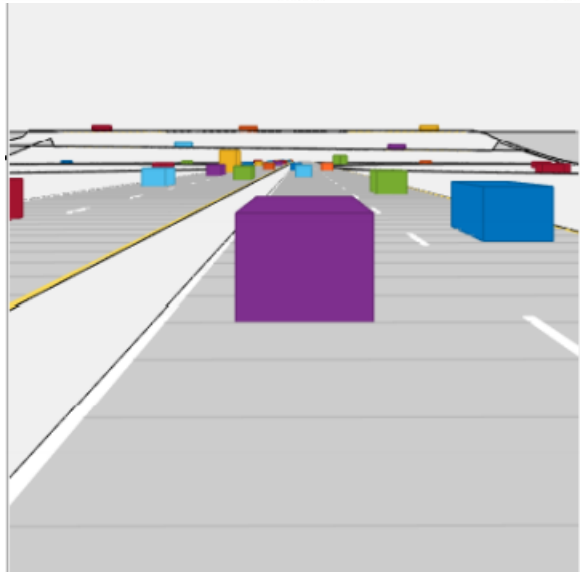
  (i) characterizes key technical challenges that are drawn in UWSNs and

  (ii) discusses methodologies to improve security and energy efficiency of an UWSN.

Simulations for Stochastic Geometry on the Performance of V2X Communications in Rural Macrocell Environment

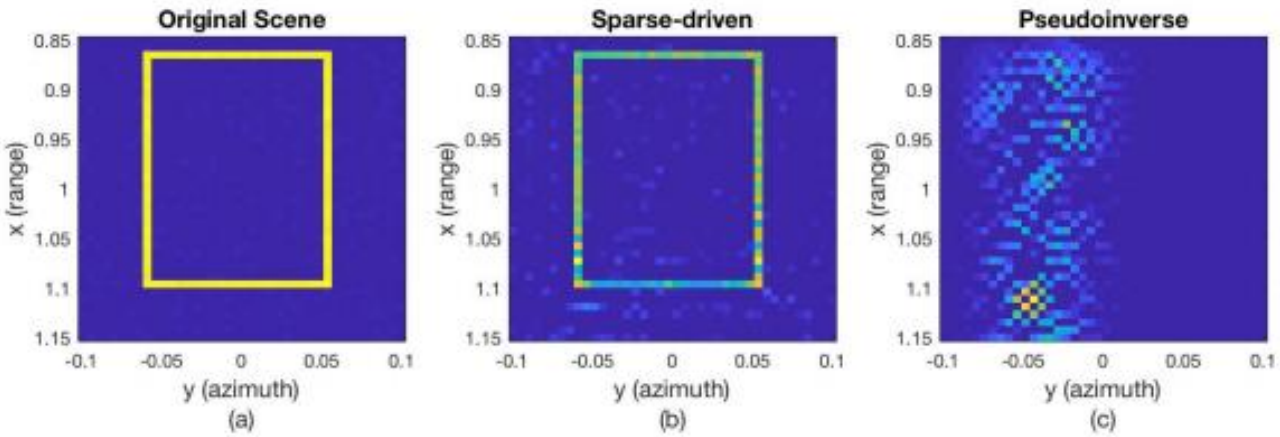
- Vehicle-to-everything (V2X) communications is a concept that has been around for the past decade. It involves communication between vehicles and other types of infrastructure. This application is exceptionally useful for emergency services such as ambulances, fire trucks etc. This is because an emergency vehicle can communicate with the traffic light infrastructure and make it give the green signal thereby allowing vehicle to pass quickly. This is useful because it alerts other cars and pedestrians on the road when an emergency vehicle is present.
- In this paper, a V2X communications system in an urban setting will be simulated using MATLAB and the Automated Driving Toolbox. The purpose of simulation in MATLAB is to test if vehicle to vehicle communication is affected by buildings and other infrastructure.
  - The first Simulation is constructed using the Automated driving simulator. In this simulation clover highway is constructed and cars are added to mimic a busy highway.
  - The second simulation involves several nodes being programmed in MATLAB and intersecting at various points to simulate an overpass highway.
  - The end goal of this project to successfully simulate a V2X communications system with additional components added within the program to represent additional cars and infrastructure





High Resolution mmWave Radar by Radar Fusion and Sparse SAR

- In automotive applications, mmWave radar has been limited to measuring the range of objects. Its limited role comes from two reasons: low resolution in 3D imaging and blind spot from specularity. A single automotive radar typically has less than 5GHz bandwidth, and therefore its distance resolution is insufficient. By fusing multiple radars operating different frequencies, the total bandwidth of the radar system can be increased. Strong specular effects of mmWave signals cause incomplete or shabby radar images due to few or none of the reflected signals back to the radar.
- We address the blind spot problem with random spatial sampling, resulting in the ability to reconstruct the radar image with missing reflected signals. The numerical results are illustrated to prove the concept.



Conclusion

- Various novel technologies related to VR/AR are introduced in the special track
- Multi-RAT is a useful technology for streaming videos, since it can achieve better data rate than using only one channel at once.
- We can expand this work to VR/AR multimedia streaming systems to improve quality of VR/AR services
- V2V and underwater communication technologies will help providing reliable connectivity solutions in various environments
- mmWave Radar technology will allow vehicles to recognize obstacles more accurately.