National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Design of Novel Algorithms for Safety Message Dissemination in IEEE 802.11p-based Vehicular Ad-hoc NETworks (VANETs)
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Venue	: Convention Hall (CS-208)
Date and Time	: 10 May 2024 (10:30 AM)

Abstract : Vehicular Ad-hoc NETworks (VANETs) enable vehicles to exchange safety-based information via broadcasts to get updates on the vehicle&rsquos speed, direction and road conditions. Highly dynamic topology, high mobility, and varying traffic density lead to network performance degradation in VANETs. MAC protocols are designed to provide reliable and rapid delivery of safety messages to safer and more efficient vehicles on the road. As vehicle density increases in the VANET environment, MAC protocols adapt to the changing data traffic patterns.

Therefore, the objective is to design novel algorithms for timely delivery of safety messages in VANET. The first approach is based on the optimization of CW with AIFS scheme to provide reliable and efficient data dissemination. Packet collision increases as vehicular density
increases. Therefore, the collision probability is computed based on the number of contending vehicles, compared with a threshold value to adapt the CW for delay-tolerant channel access. Using the Poisson distribution, a numerical analysis-based result shows the collision probability, channel throughput, delay and busy probability of channel occupancy. The analytical study is then compared with the traditional 802.11p MAC protocol of VANET.

This research work proposes an adaptive traffic flow and collision avoidance approach for vehicular platoons based on Cooperative Adaptive Cruise Control (CACC), as the second contribution. Autonomous Vehicles (AVs) travelling in platoons provide innovative solutions for efficient traffic flow management, especially for congestion mitigation, thus reducing accidents. For connected and automated vehicles, CACC systems and platoon management systems play a significant role. Platoon vehicles can maintain a closer safety distance due to the CACC system, which is based on vehicle status data obtained through vehicular communications.

The third introduces and harnesses the power of Machine Learning (ML) to learn the vehicular environment and dynamically adjust the CW parameter to maximise the throughput of a vehicular network. A Reinforcement Learning (RL) framework is formulated that compensates for actions that result in high utility by using local channel observations to overcome the absence of system knowledge. The proposed model implements a learning-based IEEE 802.11p protocol for the MAC channel control approach. The
actor-critic model effectively learns the VANET environment to provide the best reward.

The fourth approach is based on fair channel allocation to packets arriving at the MAC. The channel allocation problem is stated as a Multiple Knapsack Problem (MKP) which is proved to be NP-hard. The solution approach is based on a learning approach where the channel status is observed by the agent to take appropriate action.