講演概要：

In this work, we propose the user activity identification/channel estimation algorithm and design the efficient random access scheme for massive machine-type communications.

In the first part, we propose a transmission control scheme and design an approximate message passing (AMP) algorithm for the joint user identification and channel estimation (JUICE) in massive machine-type communications. In the proposed transmission control scheme, a transmission control function is designed to determine a user's transmission probability, when it has a transmission demand. By employing a step transmission control function for the proposed scheme, we derive the channel distribution experienced by the receiver to describe the effect of the transmission control on the design of AMP algorithm. Based on that, we design an AMP algorithm by proposing a minimum mean squared error (MMSE) denoiser, to jointly identify the user activity and estimate their channels. We further derive the false alarm and miss detection probabilities to characterize the user identification performance of the proposed scheme. Closed-form expressions of the average packet delay and the network throughput are obtained. Furthermore, we optimize the transmission control function to maximize the network throughput. We demonstrate that the proposed scheme can significantly improve the JUICE performance, reduce the average delay, and boost the throughput, compared to the conventional scheme without transmission control.

In the second part, we investigate the design and analysis of coded slotted ALOHA (CSA) schemes for massive machine-type communications in the presence of channel erasure. We design the code probability distributions for CSA schemes with repetition codes and maximum distance separable codes to maximize the expected traffic load, under both packet erasure channels and slot erasure channels. We derive the extrinsic information transfer (EXIT) functions of CSA schemes over erasure channels. By optimizing the convergence behaviour of the derived EXIT functions, the code probability distributions to achieve the maximum expected traffic load are obtained. Then, we derive the asymptotic throughput of CSA schemes over erasure channels. In addition, we validate that the asymptotic throughput can give a good approximation to the throughput of CSA schemes over erasure channels.