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Towards Achieving Confident Wireless Sensor Networks

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Abstract: Although first-generation Wireless Sensor Networks (WSNs) were designed primarily for best-effort information gathering, they are increasingly deployed for numerous performance-critical application domains. The WSNs designed for performance-critical applications must achieve stringent and assured requirements on both sensing and communication performance such as high detection probabilities, near zero false alarm rates, and bounded delays and throughputs. Failure to meet these requirements often leads to undesirable or even catastrophic consequences. However, we cannot assume convenient, but unrealistic, sensing and communication properties if we expect to meet such stringent and assured requirements. We must address existing sensing diversity, as well as the lossy, irregular, and heterogeneous WSN communication reality in real deployments. In this talk, I will present our efforts of providing sensing confidence in detail. I will also shortly discuss our efforts of providing communication confidence in support of sensing confidence.

Using a learning-based approach, we characterize and quantify sensing diversity, i.e., the sensing capability differences among individual sensors or sensor clusters in a real deployment. The learned sensing diversity is exploited to locate the needed sensing resources for meeting user-requested sensing confidence requirements in both single-hop body sensor networks and multi-hop distributed sensor systems. Compared with an existing model-driven approach that depends on modality-specific sensing models for data fusion but needs to mitigate sensing diversity, our approach is able to utilize sensing diversity by exploiting it to provide sensing confidence. In support of confident sensing, communication confidence is required for timely and reliable collection of the required sensing data. In this talk, I will also shortly discuss the research challenges as well as our solutions in providing user-specified communication throughput and time delay in body sensor networks.

Bio: Dr. Gang Zhou is an Assistant Professor in the Computer Science Department at the College of William and Mary. He received his Ph.D. degree from the University of Virginia in 2007 under Professor John A. Stankovic. He has published more than 40 wireless communication and sensor networking papers in prestigious conferences and journals. The total citations of his papers are more than 2000 according to Google Scholar, among which the MobiSys'04 paper has been cited more than 500 times. Also, he has seven papers each of which attracts more than 100 citations since 2004. Dr. Zhou served program vice chair, doctor colloquium panelist, or technical program committee positions for 42 academic conferences, including ACM SenSys, IEEE INFOCOM, IEEE RTSS, etc. He is a reviewer for 30 journals and 49 conferences. Dr. Zhou served as NSF and GENI proposal review panelists multiple times during 2008~2011. He received an award for his outstanding service to the IEEE Instrumentation and Measurement Society in 2008. He is also a recipient of the Best Paper Award of IEEE ICNP 2010.