Wireless sensor and actor networks (WSANs) are distributed systems of sensor nodes and actors that are interconnected over the wireless medium. Sensor nodes collect information about the physical world and transmit the data to actors by using one-hop or multi-hop communications. Actors collect information from the sensor nodes, process the information, take decisions and react to the events.

This dissertation presents contributions to the methods of routing, localization and positioning in WSANs for practical applications. We first propose a routing protocol with service differentiation for WSANs with stationary nodes. In this setting, we also adapt a sports ranking algorithm to dynamically prioritize the events in the environment depending on the collected data. We extend this routing protocol for an application, in which sensor nodes float in a river to gather observations and actors are deployed at accessible points on the coastline. We develop a method with locally acting adaptive overlay network formation to organize the network with actor areas and to collect data by using locality-preserving communication. We also present a multi-hop localization approach for enriching the information collected from the river with the estimated locations of mobile sensor nodes without using positioning adapters. As an extension to this application, we model the movements of sensor nodes by a subsurface meandering current mobility model with random surface motion. Then we adapt the introduced routing and network organization methods to model a complete primate monitoring system. A novel spatial cut-off preferential attachment model and center of mass concept are developed according to the characteristics of the primate groups. We also present a role determination algorithm for primates, which uses the collection of spatial-temporal relationships. We apply a similar approach to human social networks to tackle the problem of automatic generation and organization of social networks by analyzing and assessing interaction data. The introduced routing and localization protocols in this dissertation are also extended with a novel three dimensional actor positioning strategy inspired by the molecular geometry. Extensive simulations are conducted in OPNET simulation tool for the performance evaluation of the proposed protocols.

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The public is welcome to attend.