Exploiting Mobility to Enable Aerial Networking: An Overview

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Exploiting Mobility to Enable Aerial Networking: An Overview

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SUMMARY
Random mobility models for airborne networks are developed to facilitate their design and performance evaluation. Novel mobility-exploiting networking frameworks are also presented for airborne networks.

I. Introduction
Airborne networking, broadly, refers to networking in the aerial layer through direct flight-to-flight communication. Aerial networks (ANs) are envisioned a critical communication framework in the future for two reasons: 1) they shift air traffic control (ATC) from centralized and human-experience-based to decentralized and automatic, and have the potential to alleviate the burden of ATC in the National Airspace System (NAS), and 2) they enable fast information exchange, safe maneuvering, and the coordination of time-critical missions for unmanned aerial vehicles (UAVs), and enable novel UAV applications, such as unmanned delivery, firefighting, and disaster response.

Despite these advantages, airborne networking is highly challenging, considering the high mobility, frequent topology changes, and heterogeneous and complex communication environments. We envision that understanding mobility and using it for cross-layer design is crucial to the successful design and evaluation of ANs.

II. Understanding Aerial Random Mobility
Random mobility models, capturing the movement patterns of mobile agents in a statistical sense, are the core of communication evaluation environments, such as OPNET, NS2, NS3, and EMANE/CORE. Different from the mobility of ground-based systems which are featured by frequent stops and sharp directional changes, aerial vehicles tend to move straight and make smooth turns with large radii [1]. As using wrong mobility models to evaluate networking performance can lead to misleading results, it is important to develop models that capture AN-specific mobility.

We have developed AN-specific mobility models, called the Smooth-Turn (ST) Mobility Model (see [1,2,3] for the details and Figure 1 for sample trajectories). The model and its 3-D extension capture the specific mobility features of aerial vehicles, and are simple and tractable for networking design and evaluation purposes.

Figure 1: Left: A sample trajectory of the ST mobility model capturing random aerial movement; Right: a sample statistical result on node distribution.

III. Exploiting Aerial Mobility for Effective Networking
Mobility which poses challenges to robust networking, if used properly, can instead significant benefit networking. On one hand, the correlation of mobility can be exploited to predict body blockage and future trajectories and to prepare networking updates with at look-ahead time. On the other hand, the mobility of aerial vehicles can be controlled to reestablish lost connections and enable robust networking. Mobility-exploiting networking design is particularly valuable for ANs, considering the controllability of aerial vehicles, and the tight spatiotemporal correlation of aerial mobility as captured by the AN mobility models.

REFERENCES