Open problem: Energy-and time-efficient dynamic drone path planning for post-disaster network servicing

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Abstract. When a disaster strikes, the telecommunications infrastructure gets damaged making rescue operations more challenging. Connecting first responders through flying base stations (i.e. drone mounted LTE (Long-Term Evolution) femtocell base station) presents a promising alternative to support infrastructure failure during disasters [1]. The drone can travel the area and communicate with ground mobile devices, such as smartphones, and serves as flying data link to share information between survivors and rescuers.

Problem statement. *We would like to submit the following open problem to the community.* Given the position of the ground mobile devices to serve, the problem presented here is about the dynamic drone path planning. As the drone autonomy is very limited and due to the high cost of drone mounted base station, the goal of this problem is to determine the best energy-efficient and minimum-time path to travel the area as fast as possible while still remaining in range of each survivor long enough to assure full servicing. The problem can be formulated as a Close Enough Traveling Salesman Problem (CETSP) but where the following constraints apply:

– drone coverage depends on the drone altitude and speed; the drone presents a highly flexible 3-D mobility and the higher the altitude, the larger the coverage but the higher the energy consumption,

– ground nodes locations; may be dynamic since ground nodes may cooperate [2] and run an activity scheduling to periodically shut their radio off to save energy. In addition, locations are error prone,

– pitstop duration has a mandatory minimum duration and should be proportional to the number of nodes to serve at this position.

Goal. Determine the full drone trajectory at once (altitude, speed, pitstops positions and duration) to ensure a minimun energy consumption to serve all mobile devices in a minimum time.

Related work. Several solutions [3] have been proposed to 2-D CETSP. However, these approaches decompose the problem into smaller sub-problems and operate in many phases (e.g. find a feasible pitstop, compute a near optimal TSP tour and economize the found tour) leading to non-optimal solutions. Also, they assume constant speed and altitude.

Keywords: drone data link, path planning, energy efficiency

References

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