Tradeoffs between Efficiency and Fairness in Unmanned Aircraft Systems Traffic Management

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Abstract— The growing use of drones and other Unmanned Aircraft Systems (UAS) is expected to make airspace resources more congested, necessitating the use of UAS Traffic Management (UTM) initiatives to ensure safe and efficient operations. The core functions of UTM are to prevent the loss of airborne separation and to mitigate congestion at departure or arrival points. These functions can be achieved through revising the schedule by assigning airborne delays (speed changes or path stretches) or ground delays (delayed takeoff times) to aircraft. Our work evaluates the fairness aspects of delay assignment while attempting to achieve more efficient UTM. Dynamic and high traffic demand, variability in UAS operators' preferences, and differences in vehicle capabilities can adversely impact the fairness of the revised schedule. We show through computational experiments that, for certain fairness metrics, significant improvements in fairness can be attained with very little decrease in system efficiency. We also quantify the tradeoff between efficiency and fairness under dynamic demand, when trajectories are incorporated in a rolling horizon framework.