

# Drone Delivery Packing Problem on a Neutral-Atom Quantum Computer

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## Abstract

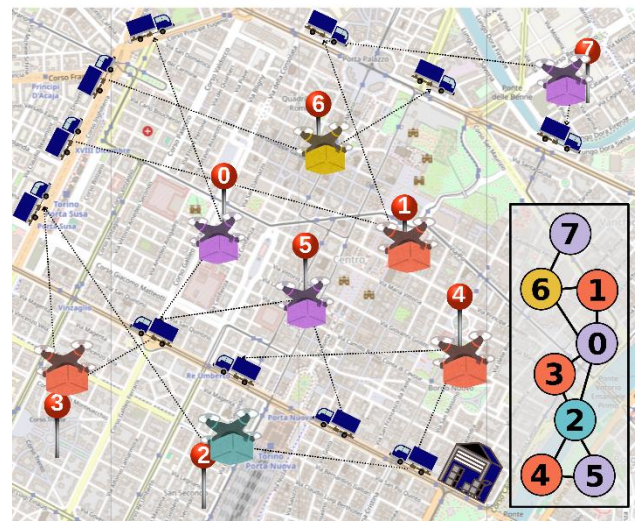
We solve the Drone Delivery Packing Problem [1] using neutral-atom quantum sampling of Independent Sets (ISs) on a scheduling graph encoding deliveries' time-incompatibilities. Samples represent candidate single-drone schedules, with the number of deliveries tunable via hardware parameters [2]. Classical post-processing addresses degeneracy and enforces battery feasibility by repairing candidates based on deliveries' energy consumption. This hybrid framework decouples time and battery constraints, reducing overall complexity. On Pasqal's Fresnel QPU, we test realistic DDPP instances with daily time windows, weight- and duration-based costs, and battery limits, showing how current NISQ technology can enable real-world logistics optimization.

## References

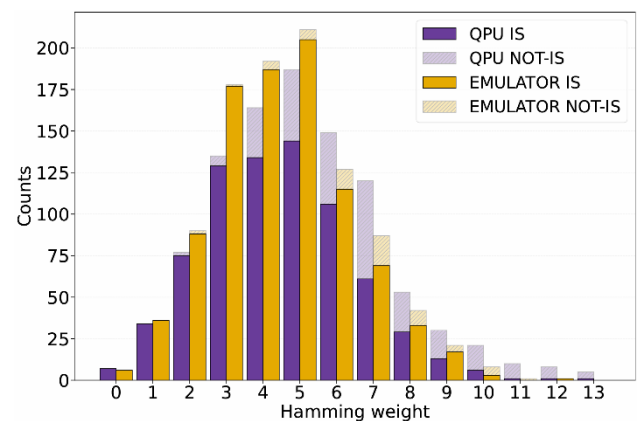
- [1] S. Tarquini, D. Dragoni, M. Vandelli, and F. Tudisco, "Testing Quantum and Simulated Annealers on the Drone Delivery Packing Problem," *Quantum Machine Intelligence*, accepted for publication (in press), 2024. arXiv:2406.08430.
- [2] M. D. Lukin, M. Fleischhauer, R. Cote, L.-M. Duan, D. Jaksch, J. I. Cirac, and

P. Zoller, "Dipole Blockade and Quantum Information Processing in Mesoscopic Atomic Ensembles," *Phys. Rev. Lett.* 87, 037901 (2001).

## Figures



**Figure 1:** Multiple drones, carried by a moving truck, distribute parcels to users across a given territory. In the scheduling graph, adjacent nodes correspond to deliveries overlapping in time. ISs represent time-feasible schedules.



**Figure 2:** Distribution of ISs for a 100-delivery instance; the battery budget limits the desirable schedules to a medium size. Targeted samples are generated, post-processed, and combined in a global schedule.