Developing a Novel Public Intra-city Small- to Medium-sized Cargo Distribution System for Cities of the Future

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The growth of online commerce has increased freight truck density on city streets, consequently worsening congestion and carbon emissions while limiting logistical efficiency. This investigation develops a novel public intra-city small- to medium-sized cargo delivery system as a means to improve logistical efficiency while reducing carbon footprint. The system, High-Efficiency Rail Based Modular Electric Shipping (HERMES), utilizes a hybrid propulsion mechanism that combines linear synchronous motors (LSM) and rotary motors, maximizing acceleration through LSMs and minimizing cost and power consumption through rotary motors. The capsule-based design reduces redundant routes and eliminates the need for a central sorting warehouse while the modular rail design minimizes infrastructure footprint and cost. HERMES's closed-loop system allows future full autonomous operation, increasing cargo mass flow rate by maximizing rail usage. To minimize the "last mile" distance, the system transports cargo between distribution centers (HERMES stations) situated around the city. To analyze the overall performance of the system, kinematic and energy data obtained from experimental launch tests were used as parameters for traffic simulations. In various simulated environments adapted from accurate street map data, HERMES consistently reduced both cargo delivery time and mean travel time. In the future, HERMES will be implemented within cities as a public freight system, delivering cargo from one HERMES station to another. Implementing HERMES could potentially benefit governments and companies through increasing goods mobility and generate invaluable social benefits through improving consumer convenience and reducing the carbon footprint from intra-city logistical services.

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