Resistojet Nozzle Final Abstract

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**This research presents an analytical investigation into the thermal enhancement of a conventional cold gas micro-thruster through the integration of a resistively heated element. Cold gas thrusters are widely utilized for small spacecraft due to their mechanical simplicity, low mass, and inherent reliability; however, their performance is limited by low specific impulse resulting from unheated propellant expansion. This study addresses that limitation by incorporating a resistive heating element—modeled as a cylindrical wire with internal Joule heating and convective loss—wrapped around the propellant flow path, forming a compact resistojet configuration.**

**A one-dimensional steady-state heat conduction model was developed to predict temperature distribution along the wire, accounting for volumetric heat generation, surface convection, and fixed boundary temperatures. Both constant-voltage and constant-current power supply scenarios were examined analytically to evaluate their influence on maximum surface temperature and thermal control. Material candidates including nichrome, constantan, and copper were compared based on their electrical resistivity and thermal conductivity to assess their suitability for controlled heating in low-power propulsion environments.**

**The results demonstrate that careful selection of material properties and geometric parameters enables significant temperature control using low-voltage and constant-current inputs. This analytical framework offers a low-complexity approach to improving the thermal energy of cold gas thrusters, thereby increasing exhaust velocity. The findings support the feasibility of analytically designed resistojets for CubeSat and micro propulsion applications where simplicity, efficiency, and precise thermal management are critical**.