Assessing EHD thrust using rotational motion

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***Abstract* — The ionic wind, which also includes neutral molecules, is produced by a highly non-uniform electric field enticing the directed flow of the surrounding fluid medium towards a ground collector via ionized particles. In spite of the great interest in the Electrohydrodynamic (EHD) thrust there is still scarcity of data regarding the process. Contrary to a static setup in which the EHD emitters are at rest and scales are used for assessing the thrust, in our setup the EHD propulsion creates torque and rotational motion of ionic spinners. Using this method, we aim to complete the present characterization of the EHD thrust. The use of a rotational EHD configuration provides a practical means to measure the thrust generated without the use of expensive, sensitive scales that may be damaged by the electric field as well as prone to errors in high electric fields. Moreover, the method seems very sensitive to testing properties difficult to assess in the static setups. By applying high voltage to hand-made, radially symmetric EHD needle thrusters/ spinners surrounded by a coaxial ground electrode to generate rotational motion the thrust can be measured. Calculating the spinner's moment of inertia and experimentally determining its angular acceleration and terminal velocity allowed the characterization of the thrust in the regime of negligible drag and maximum drag (terminal speed). Test parameters focused on include pin emitter density, length, and sharpness. The EHD thrust is a more efficient propulsion process than what conventional jet engines have to currently offer. From our experiments the efficiency of the needle emitted EHD thrust appears to peak at rather low voltages. The thrust at small angular velocities shows a quadratic variation with the applied voltage.**