Modeling Of Charged Droplet Dynamics In An Electric Field Using COMSOL Multiphysics®

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Abstract

In the field of coding and industrial marking areas, CIJ technology is based on high speed emission of ink drops (20 m/s) which are directed onto a moving printing medium.
The printing quality depends, on one hand, on drops position on the media determined by the drop charge and the electrostatic field, and on the other hand, on the position accuracy which depends on unwanted drops interaction in flight (electrostatic repulsion and aerodynamic effects). For instance, in a 24-points matrix, there are 2^24 combinations which cannot be predetermined experimentally. COMSOL Multiphysics® enables to model these coupled effects in order to predict the location of a drops line on the medium, and this way, to create an aid to design CIJ printer heads.
First, the 2D electrostatic field, defined mainly by the electrodes geometry, is computed thanks to the COMSOL Multiphysics® AC/DC Module. Then, the COMSOL Multiphysics® Particle Tracing Module is used to compute the droplet trajectory in the electrostatic field by modelling the droplet as a charged material point subjected to the Lorentz force and the Coulomb one. This electrostatic repulsion, describing the droplet-droplet electrostatic interaction, is taken into account thanks to the Particle Tracing Module.
This paper describes the coupled model which allow to compute droplets trajectory until the prediction of droplet positions on the printing media. Numerical results are compared to experimental data to validate the predictions quality and the model as a design support tool.

Figures used in the abstract

Figure 1 : Electric streamlines and Electric Field in the print head

Figure 2 : Droplet raster in flight