Hydrodynamic Interactions of Spherical Particles and Inkjet Printing

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In continuous inkjet printing system array of drops are generated and jetted onto the substrate. The control of aerodynamic interactions among drops is critical to drop placement accuracy and hence image quality. The motion of small spherical drops of unequal sizes is based on low Reynolds number approximation. We employ the Stokesian dynamics formulation [1] to compute the interaction forces between drops. The method is accurate and computational efficient and allows us to follow the trajectories of hundreds of drops in a reasonable time. The method is based on the integral representation of velocity field in Stokes flow [2] and the Taylor expansion of the Green function for the Stokes flow around the center of each drop. This gives us a relation between velocities of the drops and the forces exerting on the drops. When the drops are close, the analytical solutions to interactions of the two spheres case are employed [3]. By combining far field and near field interactions and adjusting for the contribution of near field, this provides an accurate method of computing forces on the drops from their velocities.

A typical inkjet drop volume is 3 to 10 picolitre and spacing between jetting nozzles is 42.3 micron in 600 dpi printing. The drops are staggered when they are jetted from the nozzle to minimize the interactions between drops. The model allows us to optimize the staggered scheme and to eliminate the artifact of the staggered scheme.

The jetting speed of the drops is about 20 m/s. The Reynolds number in this case is about 10. The results from the model have been compared with the actual printings and they are in good agreement.

† Unpublished. ISCST shall not be responsible for statements or opinions contained in papers or printed in its publications.

References

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