LASER ABSORPTION TOMOGRAPHY RECONSTRUCTION THROUGH THE LEVEL SET METHOD

Matthew G. Twynstra, Kyle J. Daun, and Steven L. Waslander
University of Waterloo
200 University Ave. West, Waterloo, Ontario, Canada, N2L 3G1

ABSTRACT. Laser absorption tomography is an emerging diagnostic for mapping the concentration of a gaseous species. Since laser absorption measurements alone are insufficient to specify a unique concentration distribution reconstruction algorithms must incorporate additional information that promotes presumed physical attributes of the concentration distribution. This paper pioneers the application of the level set method to chemical species tomography. The species concentration distribution is initially represented by a signed distance function, which is progressively deformed by forces that scale with the difference between the measured and simulated absorption data as well as deviation from a spatially smooth solution. The final concentration distribution explains the laser absorption measurements and is also qualitatively consistent with mixed advection/diffusion transport. The algorithm is demonstrated by solving a simulated laser tomography experiment on a turbulent methane plume.