Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

A Controls-CFD Approach for Estimation of Concentration from a Moving Aerial Source: Advantages of a Finite Volume-TVD implementation with Guidance-Based Grid Adaptation TATIANA EGOROVA, NIKOLAOS A. GATSONIS, MICHAEL A. DEMETRIOU, Worcester Polytechnic Institute — In this work the process of gas release into the atmosphere by a moving aerial source is simulated and estimated using a sensing aerial vehicle (SAV). The process is modeled with atmospheric advection diffusion equation, which is solved by the finite volume method (FVM). Advective fluxes are constrained using total variation diminishing (TVD) approach. The estimator provides on-line estimates of concentration field and proximity of the source. The guidance of the SAV is dictated by the performance of the estimator. To further improve the estimation algorithm from the computational prospective, the grid is adapted dynamically through local refinement and coarsening. The adaptation algorithm uses the current sensor position as a center of refinement, with the areas further away from the SAV being covered by a coarse grid. This leads to the time varying state matrix of the estimator and the variation depends on the SAV motion. Advantages of the adaptive FVM-TVD implementation are illustrated on the examples of estimator performance for different source trajectories.

Tatiana Egorova
Worcester Polytechnic Institute

Date submitted: 31 Jul 2013 Electronic form version 1.4