

# Applications of the theory of carrier support for environmental/industrial protections against foreign substances

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## Abstract

We discuss a problem in environmental (industrial) protection (quality control) against threatening foreign (impure) substances whose dispersion throughout realistic domains of interest is governed by the parabolic partial differential equations of convective-diffusion. The larger problem at hand, that of finding the (time-varying) position (and strength) of an unknown and hazardous source is an inverse source problem for a general diffusion equation with constant coefficients and a source whose support and strength may vary with time. We review that knowledge of the solution on any bounded open set  $M$  in  $\mathbb{R}^n$  located away from the source for any fixed time  $T > 0$  determines the so-called "carrier support" [as originally defined in the article, Notions of support for far fields, J. Sylvester, Inverse Problems, pp. 1273-1288, Vol. 22, 2006 and further examined in, Identification and characterization of a mobile source in a general parabolic differential equation with constant coefficients, S. Kusiak and J. Weatherwax, SIAM Journal of Applied Mathematics, Vol. 68, No. 3, pp. 784-805, 2008], (a nontrivial subset of the support of the true source) at that coincident time. Moreover, we provide and detail a robust reconstruction algorithm which is able to locate the time-varying position of the carrier support of the foreign source, and discuss several numerical examples which establish the efficacy and robustness of this location and tracking method.

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