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# TWO-DIMENSIONAL TOMOGRAPHIC RECONSTRUCTION IN COMBUSTION FLOWS USING MULTIPLE ABSORPTION TRANSITIONS

**Abstract**

- Tunable diode laser absorption tomography (TDLAT) combines tunable diode laser absorption spectroscopy (TDLAS) with tomographic image reconstruction. The 2D information of the flow field (usually temperature, concentration, pressure) has been recorded from multiple angles of line-of-sight measurements in a test plane. TDLAT becomes one of the most promising technique for combustion diagnostics, due to its merits of fast response, non-intrusion and spatially distribution access.

- A lot of researches have been done on the TDLAT to improve the reconstruction quality, because of the limit of the installation space and projected beams in combustion engines. Two absorption transitions with different temperature sensitivities are usually used in TDLAT measurement. However, during the combustion process, there are different conditions with a large temperature range. In order to adapt the change of the flow field and capture the 2D flow fields in a high quality, we develop a new reconstruction method with multiple absorption transitions, which is named multiple absorption transitions combination optimization (MATCO) method. Firstly, we judge the maximum temperature range of flow field and choose more than three lines based on selection criteria for optimal line pair., two lines are used as a basic line pair, by which the temperature distribution is reconstructed. Secondly, the flow field is divided into a few small regions by different temperature ranges. Lastly, the small regions are re-reconstructed using the line pairs which are optimal for the temperature range. In this paper, we selected four H2O lines to reconstruct the temperature distribution with a range of 300 - 1500 K. Different models were used in the numerical simulations. The simulation results shows that MATCO method can improve the reconstruction quality with reconstructed error of 0.0396 comparing with two-line thermometry of 0.0952.

- Compared with traditional two-line thermometry, MATCO method can choose the proper lines according to the temperature range and have a high reconstruction quality. Also different from the hyperspectral method, MATCO method does not need to solve the nonlinear equations and have high computational efficiency.