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TOMOGRAPHY FOR TWO-DIMENSIONAL GAS TEMPERATURE DISTRIBUTION BASED ON TUNABLE DIODE LASER ABSORPTION SPECTROSCOPY

Abstract

Based on tunable diode laser absorption spectroscopy, the algebraic iterative reconstruction is used to reconstruct the combustion gas temperature distribution. The effects of number of rays, number of grids and spacing of rays on the temperature reconstruction results for parallel ray are researched. The reconstruction quality increases with increased the ray number, and get better with increased the grids. When the ray number exceeds a certain value, the quality tends to be smooth. With the number of rays increasing, when the ratio of the spacing between rays to the width of the unit grid is between 0.5 and 1, the quality is the best.

A virtual ray method combined with the reconstruction algorithms is proposed. Two methods of grid division to match the virtual ray are proposed. One of them is to keep the size of original area the same, and increase the number of grids. The other is to slightly narrow the size of original area, and increase the number of grids. The former is superior to the latter, improving 1.5 times resolution. It's error decreases to 1/3 of the original. In addition, the virtual ray method is effective to improve the accuracy of reconstruction results, compared with the original method.

We find that absorption value of virtual rays is a very important factor for the reconstruction quality. Two ways, linear interpolation and cubic spline interpolation, are used to improve the accuracy of calculating the absorption value of virtual rays. According to the calculation results, cubic spline interpolation is better.

Moreover, the temperature distribution of a TBCC combustion chamber is used to validate those conclusions.