研究室名	錦研究室　学会発表

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学会名	38th International Symposium on Combustion
演題名	Application of Helmholtz-Hodge decomposition and conditioned structure functions to exploring influence of premixed combustion on turbulence upstream of the flame
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内容	In order to explore the influence of combustion-induced thermal expansion on turbulence, a new research method is introduced. The method consists in jointly applying Helmholtz-Hodge decomposition and conditioned structure functions to analyzing turbulent velocity fields. Opportunities offered by the method are demonstrated by using it to process Direct Numerical Simulation data obtained earlier from two statistically 1D, planar, fully-developed, weakly turbulent, single-step-chemistry, premixed flames characterized by two significantly different (7.52 and 2.50) density ratios, with all other things being approximately equal. To emphasize the influence of combustion-induced thermal expansion on turbulent flow of unburned mixture upstream of a premixed flame, the focus of analysis is placed on structure functions conditioned to the unburned mixture in both points. Two decomposition techniques, i.e. (i) a widely used orthogonal Helmholtz-Hodge decomposition and (ii) a recently introduced natural Helmholtz-Hodge decomposition, are probed, with results obtained using them being similar in the largest part of the computational domain with the exception of narrow zones near the inlet and outlet boundaries. Computed results indicate that combustion-induced thermal expansion can significantly change turbulent flow of unburned mixture upstream of a premixed flame by generating anisotropic potential velocity fluctuations whose spatial structure differ substantially from spatial structure of the incoming turbulence. The magnitude of such potential velocity fluctuations is greater than the magnitude of the solenoidal velocity fluctuations in the largest part of the mean flame brush in the case of the high density ratio. In the case of the low density ratio, the latter magnitude is larger everywhere, but the two magnitudes are comparable in the middle of the mean flame brush. Contrary to the potential velocity fluctuations, the influence of the thermal expansion on the solenoidal velocity field in the unburned mixture is of minor importance under conditions of the present study.