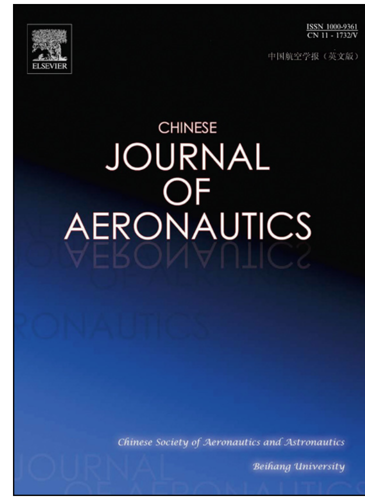
Accepted Manuscript



Review Article

Particle image velocimetry for combustion measurements: Applications and developments

Fang Chen, Hong Liu

PII: S1000-9361(18)30172-9
DOI: https://doi.org/10.1016/j.cja.2018.05.010
Reference: CJA 1065

To appear in: *Chinese Journal of Aeronautics*

Received Date: 30 June 2017
Revised Date: 29 September 2017
Accepted Date: 25 November 2017

Please cite this article as: F. Chen, H. Liu, Particle image velocimetry for combustion measurements: Applications and developments, *Chinese Journal of Aeronautics* (2018), doi: https://doi.org/10.1016/j.cja.2018.05.010

Chinese Journal of Aeronautics 28 (2015) xx-xx

Contents lists available at ScienceDirect

Chinese Journal of Aeronautics

journal homepage: www.elsevier.com/locate/cja

Final Accepted Version

Particle image velocimetry for combustion measurements: Applications and developments

Fang CHEN [a,*], Hong LIU [a]

[a]*School of Aeronautics and Astronautics, Shanghai Jiao Tong University, Shanghai 200240, China*

Received 30 June 2017; revised 29 September 2017; accepted 25 November 2017

Abstract

In the last several decades, Particle Image Velocimetry (PIV) has reached a high degree of maturity as a laser diagnostic technique based on tracer particles, with significant improvements in accuracy, resolution, dynamic range, and as an extension to combustion measurements. To assess the recent developments and to project the future trends of using the PIV technique for combustion measurements, we review many key issues for measuring combustion flow fields. We introduce the representative applications of a supersonic combustor and swirling burner and summarize the promising prospects and further development requirements of PIV measurements in combustion flow fields.

Keywords: Tracer particles; Laser; Velocimetry; Combustion; Diagnostics

*Corresponding author.
E-mail address: fangchen@sjtu.edu.cn

Nomenclature

h	Planck constant	v	velocity at y direction
v_R	frequency-shifted for Raman scattering	w	velocity at z direction
v_0	frequency of laser beam	H	height
v_f	frequency-shifted for fluorescence	v_{ave}	time-averaged velocity
Ma	Mach number	v_{RMS}	RMS velocity
Δp	pressure difference	r	radius
ε_u	bias error	β	maximum planar angle
ε_{urms}	Root-Mean-Square (RMS) velocity error	α	angle between Camera 1 and Camera
Δt	time between laser pulses	λ	wavelength
Δx	particle displacement at x direction	D	diameter of coflow
Δy	particle displacement at y direction	ω^2	$\omega^2 = \lvert\boldsymbol{\omega}\cdot\boldsymbol{\omega}\rvert$, $\boldsymbol{\omega}$ is the vorticity vector
u	velocity at x direction		

1. Introduction

Combustion is an important process in aircraft engines, gas turbines, ramjets, rockets, and internal combustion engines. The foundation of combustion research depends greatly on the physical, mathematical, and numerical modeling of the combustion process. Newly developed or improved models require the assessment and validation of experimental measurements, which are mostly obtained from simplified or specified combustion devices and are commonly based on laser diagnostics. These laser diagnostics generally have the advantages of non-intrusiveness,