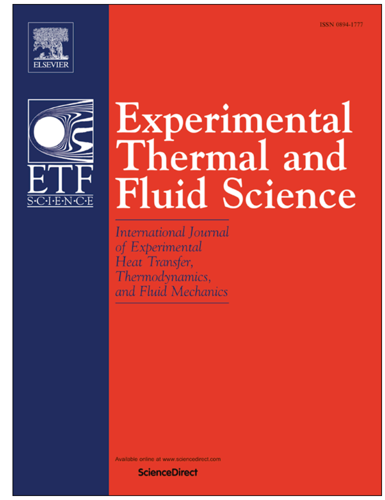
Accepted Manuscript



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PII: S0894-1777(18)30200-0
DOI: https://doi.org/10.1016/j.expthermflusci.2018.02.014
Reference: ETF 9375

To appear in: *Experimental Thermal and Fluid Science*

Received Date: 19 September 2017
Revised Date: 4 December 2017
Accepted Date: 10 February 2018

Please cite this article as: A. Amoresano, C. Allouis, M. Di Santo, P. Iodice, G. Quaremba, V. Niola, Experimental characterization of a pressure swirl spray by analyzing the half cone angle fluctuation, *Experimental Thermal and Fluid Science* (2018), doi: https://doi.org/10.1016/j.expthermflusci.2018.02.014

EXPERIMENTAL CHARACTERIZATION OF A PRESSURE SWIRL SPRAY BY ANALYZING THE HALF CONE ANGLE FLUCTUATION

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Abstract: Pressure swirl sprays are frequently used in burners for gas turbines like the LPP chamber or to generate diffusion flames. Combustion between fuel and the air is governed by complex phenomena determined by the mixing of the mass flow rate of the two phases liquid and gaseous. Characterization of the spray by measuring the half cone angle fluctuations with a speed camera and a Lagrangian approach allows the working space of the spray to be defined and the "signature" of the spray in well-defined conditions of supply pressure to be identified. The results define the pseudo-chaotic structure of the spray and highlight behavior affecting the combustion process.

Key-words: Spray, Pressure Swirl Spray, Chaos, Stationary Random Process, Image Processing, Nonlinear Analysis

1. Introduction

Spray systems are widely used in industrial applications, representing an easy way to optimize such processes as mixing inside a combustion chamber, heat exchange in the pharmaceutical industry, and ink deposition in the print industry. All types of spray generate a particular droplet distribution like D_{32} and $Dv_{0.5}$ [1][2], depending on the geometry of the atomizer, on supply conditions, on the fluid injected, and so forth. Furthermore, the atomization process generates a velocity field for each droplet size that develops both in an axial and radial direction [3]. The behavior of a spray system can be studied by analyzing either its morphology, its fluid dynamic characteristics, or both. As a consequence, the study of droplet distribution yields considerable information about the momentum exchange and how mixing mechanisms are governed. Analysis of the geometrical parameters gives information on the interaction between the gas and liquid phase and determines spray morphology [4]. Furthermore, the liquid jet may, or may not, impact and penetrate in quiescent gas, thereby causing phenomena of momentum exchange. Therefore, the spray interacts strongly with the surrounding gas, as in combustion processes, or can interact briefly, as in printing devices. Analyzing all the above assumptions, it may be concluded that a spray does not generate instantaneous steady behaviors except when it is averaged over time. In the latter case the spray can be considered pseudo stationary. In other words, spray behavior can be analyzed either by averaging the governing parameters along time or by considering their instantaneous values.