

A simplified ω -ALDF rank-correlated full-spectrum k -distribution model for combustion applications

Jean-Louis Consalvi^{1*}, Fatiha Nmira², Frédéric André³, Vladimir P. Solovjov⁴, Brent W. Webb⁴

¹Aix-Marseille Université, IUSTI UMR 7343, 5 rue E. Fermi, 13453 Marseille cedex 13, France

²Direction R&D EDF, 6 Quai Watier, 78401 Chatou Cedex, France

³Univ Lyon, CNRS, INSA-Lyon, CETHIL UMR5008, F-69621 Villeurbanne, France

⁴Brigham Young University, 360G EB, Provo, UT 84602, USA

ABSTRACT. The objective of this paper is to present a method that allows simplifying the use of ω -absorption line distribution functions inside rank correlated full-spectrum k -distribution models for application in combustion problems. In this simplified version, the ω -ALDF is constructed without any a priori information on the problem treated. It can be used directly but, in order to simplify further the concept for possible users, we suggest here approximating this ω -ALDF using an ALBDF at a temperature defined in terms of the ω -ALDF. The method is validated in some combustion scenarios. The model is assessed by comparison with a narrow band correlated- k model through decoupled radiative simulations of eight turbulent axi-symmetric non-premixed jet flames covering a wide range of optical-thicknesses and contributions of soot to radiation. The predictions are within 4% of the reference solution, providing an efficient model for CFD simulations of combustion problems.

* Corresponding Author: jean-louis.consalvi@univ-amu.fr.