- Title: *A-priori* analysis of joint PDF of mixture fraction and progress variable trained using machine learning techniques.

- Session: 31.4 Reacting flows: LES

- Authors: Marc T. Henry de Frahan, Shashank Yellapantula, Ryan King, Ray Grout, Marc Day

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In this study, we use supervised machine learning (ML) techniques to investigate models in the context of presumed PDF based LES techniques. A key modeling uncertainty associated with the presumed PDF methods is the shape of the joint PDF. In the current study, data from reacting DNS of the Low-Swirl burner (LSB) with methane as fuel (Day et al. Combust Flame. 2012) are used to develop models using ML techniques for joint PDF shape prediction. DNS data in the form of the joint PDF of moments of passive and reacting scalars, namely mixture fraction and progress variable, are used as the training set. Using a-priori analysis, we demonstrate the performance of traditional ML models and recent deep learning (DL) methods. Joint PDF predictions are convoluted with conditional means of the progress variable source term to help comparing various PDF shapes. Comparisons of random forest regression, a traditional ML technique, with two different types of deep neural networks, a fully-connected feed forward neural network and a generative adversarial network, indicate that the DL techniques produce more accurate joint PDFs.

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**References**

[1] Day M, Tachibana S, Bell J, Lijewski M, Beckner V, Cheng RK. A combined computational and experimental characterization of lean premixed turbulent low swirl laboratory flames: I. Methane flames. *Combust Flame*. 2012;159(1):275-290