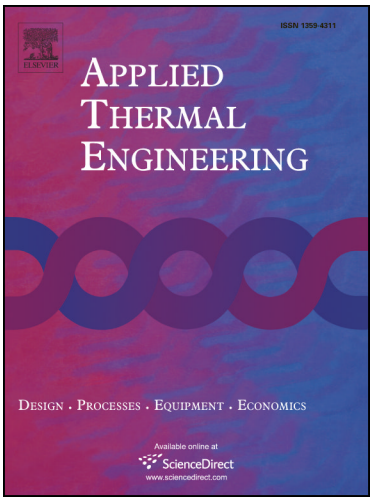

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A new knock event definition for knock detection and control optimization

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Abstract

In this paper, the knock phenomenon is studied and characterized in the time-frequency domain. From the analysis results, a new knock event definition is proposed, which compares the excitation of the cylinder resonance produced by the autoignition of the end gas to that associated with the combustion. The new definition permits a more consistent differentiation between knocking and not knocking cycles than the classical approach in the literature, thus allowing the improvement of the knock control strategies.

The new knock index proposed analyses the frequency spectrum of the pressure signal in two locations, i.e. near the maximum heat release and near the end of combustion, by using the fast Fourier transform and a window function, and it is compared with the classical MAPO definition, which consists on finding the maximum pressure oscillation in the time domain. Both indices have been implemented online in a four-stroke SI engine and its performance is illustrated by using a classical knock control strategy. Results obtained under different operating conditions demonstrate that the improved knock index definition can substantially reduce the variability of the spark advance angle control, avoiding strong knocking events and reducing engine vibration.

Key words: Knock, SI engines, STFT, resonance, control

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