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Buzz-Saw Noise : propagation of shock waves in aero-engine inlet ducts

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When high bypass ratio aircraft engines run at take-off operating conditions, blade relative flow velocities can exceed sonic speed, thus generating forward propagating shock waves that spiral inside the intake before being radiated. "Buzz-saw" or "multiple pure tone" noise then occurs, and measured acoustic spectra close to the fan display tones at the blade passing frequency and its harmonics, along with those of the engine shaft rotation frequency.
This work first attempts to reformulate McAlpine and Fisher's frequency domain model for the propagation of a sawtooth waveform spiralling inside a hard-walled and lined cylindrical duct with uniform flow. The non-dissipative Burgers equation is solved, and modal attenuation and dispersion are added using a split-step computational method.
In practice, shocks do not only occur at blade tips, but on a significant portion of the blade span. The plane wave hypothesis being no longer valid, a new three dimensional model is presented for a no-flow case. This model is based on the computation of the axial variations of the mode amplitudes under the influence of the nonlinear modal interactions. The formalism of this new model, along with the preliminary results are also presented.