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Prediction of overblowing behavior of an organ flue pipe

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The sound of an organ flue pipe originates from oscillation of an air jet in the mouth. The oscillation is caused by fluid dynamical instability of the jet itself and by sound generated in the flue pipe. The phase and magnitude of jet oscillation relative to sound is essential to determine which acoustic mode is excited as well as the spectrum of the generated sound. Because the theory of the oscillating jet has only been developed with several assumptions such as an inviscid flow, a jet of infinite length and a fixed velocity profile, an experimental method should be employed to develop a model of the actual jet motion. In this research, this was done numerically. Using the finite element method (FEM), a jet initially having a square-shaped velocity profile that is deflected by sound was simulated. The results were analyzed to obtain change in the velocity profile, the phase and the magnitude of the jet oscillation amplitude. Based on these analyses, a jet oscillation model was developed. With this model, incorporated with a physical model of an organ flue pipe, overblowing behavior with change in blowing pressure was estimated. The predicted behaviour was compared with the experimental results.