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Automated fingering services for woodwinds: development of a "virtual clarinet"

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The Virtual Flute is a popular web service that recommends alternative fingerings for difficult passages, timbre variations, intonations or multiphonics. Its database was generated by a machine-learned expert system analysing waveguide models for all 39,744 fingerings. The relatively simple geometry of the flute and its tone holes allowed a simple yet accurate model.

The development of similar systems for other woodwinds faces greater modelling and computational challenges. For example, the clarinet has a more complex geometry, with tone holes whose radius and length vary by factors of 4.2 and 2.8. Further, it has several million different fingerings.

To achieve the required accuracy, individual measurements of each hole separately and of mouthpiece and bell, as well as several dozen fingering examples, were used to determine parameters of a still simple waveguide model. The model uses conical and cylindrical segments with parallel and shunt impedances at junctions, representing tone holes. This approach of incrementally enhancing our waveguide model allows computational advantages: an efficient, woodwind-generic software framework is built that can adapt to the instrument of interest. We report interim results with such a system, with further potential applications in the design of woodwind instruments and other acoustic duct systems.