Simplified formulas for the quantitative evaluation of the curvature-induced mistuning in wind instruments

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When a duct is curved, as it is often the case in wind instruments, the induced shift in the resonance frequencies of the air column is frequency dependent, resulting in a complex, though generally small, inharmonicity. As, in cases of strong curvature, this inharmonicity can be musically significant, one wishes to take it into account in models and simulation tools, in order to predict accurately the acoustical properties of a wind instrument. To this end, we describe first an exact formulation of the sound propagation in a curved duct. Then, we derive simplified formulas, that allows to account for the effect of the curvature in a simple, 1D, model of the wave guided propagation.