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Optimization problem for the automatic positioning of flow obstructions to control tonal fan noise

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Tonal noise from subsonic axial fans can be controlled by adding obstructions in the downstream or upstream flow field of the rotor. These obstructions must be located with care to create secondary circumferential modes of the blade unsteady lift of equal magnitude but opposite in phase with the primary unsteady lift modes responsible for the tonal noise. The general optimization problem of controlling N circumferential modes using N obstructions with 2 degrees of freedom or 2N obstructions with 1 degree of freedom is first posed. This optimization problem can be greatly simplified using nB-perdiodic obstructions (where B is the number of blade) designed to control the most radiating mode of the blade unsteady lift at frequencies n×BPF. In this case, the control of each frequency is uncoupled and a single error microphone in the axis of the fan can be used to globally control the selected frequencies.