

Supplementary Material - Resonant Beam Steering and Carpet Cloaking using Acoustic Transformational Metascreen

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Simulation of Periodic Array of Binary Cells and Transformational Screen

It is assumed that the transformational metascreen resides in air. Therefore incident plane wave travels in air medium. The density and speed of sound in air are $\rho = 1.22\text{kg}/\text{m}^3$ and $c = 343\text{m}/\text{s}$ respectively. These properties are used in finite element software COMSOL multiphysics.

The binary cell array are simulated in COMSOL acoustics module in which incident sound waves hits the cavity cells. Cavity cells are assumed to be infinite along lateral direction. As the cavity cells are made of acoustically rigid material, therefore surfaces of cavity cells are

defined as hard boundaries. Periodic boundary conditions are applied on left and right side boundaries to extend the domain to infinity. At the top, a perfectly matched layer (PML) domain is used to terminate the simulation space and model an infinitely large air domain. Port boundary conditions are used to excite the structure located above the resonator.

The transformational screen is simulated with inclusion of several binary cells tuned to provide desired phase. The source excitation and PML implementations are same as periodic binary cells. The tunability feature is controlled by scaling the height of a cell i.e., s_i inside binary-cell (see manuscript for more details). Considering large number of binary-cells to construct metascreen, it is difficult to control the heights of cavity resonators individually for each binary cell. Therefore, programmable interface was used to control the geometrical features of binary-cells. A sample geometry of the modeled binary-cell resonator embedded in background air medium is shown in the following figure.

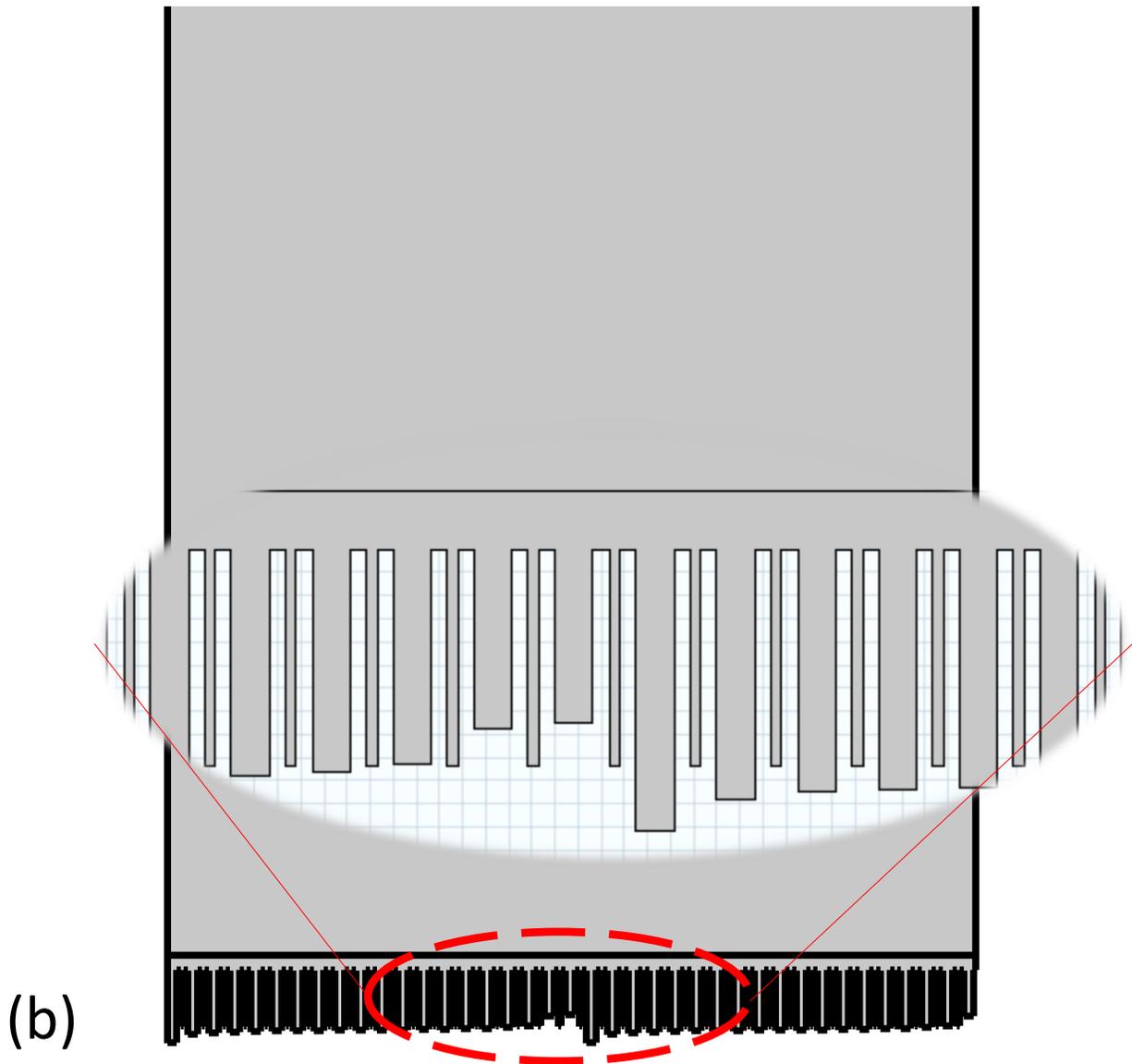
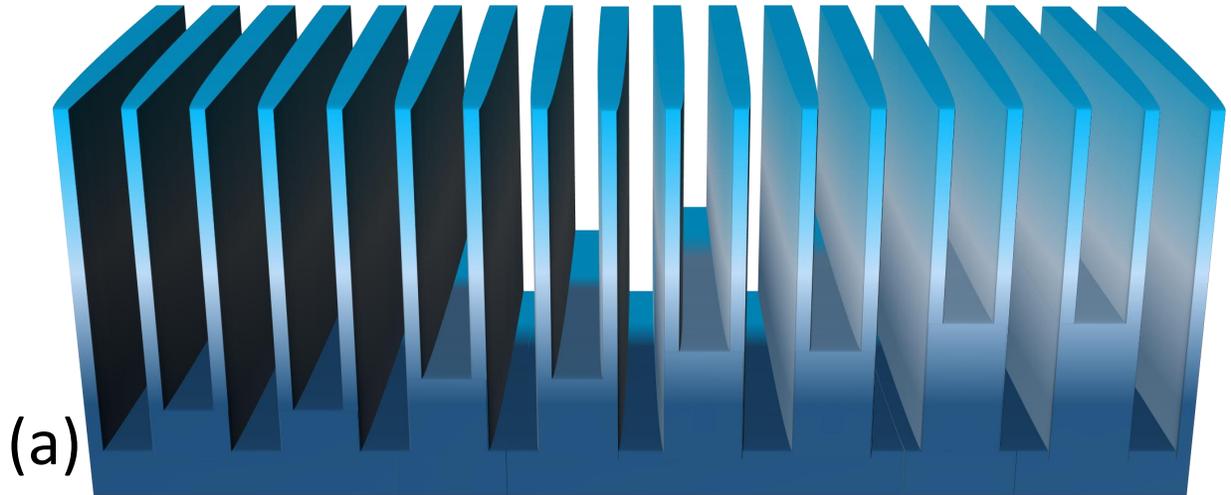


Figure 1: A transformational metascreen geometry for virtual metascreen defined in (a) schematic illustration (b) COMSOL.