Wave impedance retrieving via Bloch modes analysis - DTU Orbit (04/08/2019)

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The main bottleneck in the restoration of electromagnetic effective parameters is connected to the impedance retrieving. The S-parameters method gives the input (Bloch) impedance, which, being then used for permittivity and permeability determination, causes some fundamental physics principles violation, like antiresonance behaviour with \( \text{Im}(\varepsilon) < 0, \text{Im}(\mu) < 0 \). We employ the Bloch mode analysis of periodic metamaterials to extract the dominating (fundamental) Bloch mode. Then it is possible to determine the Bloch and wave impedances by the surface and volume averaging of the electromagnetic field of the Bloch mode, respectively. Case studies prove that our approach can determine material and wave effective parameters of lossy and lossless metamaterials. In some examples when the passivity is violated we made further analysis and showed that this is due to the failure of concept of impedance retrieving through the volume averaging.

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