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'Maxwellian' macroscopic acoustics and acoustic metamaterials

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For electromagnetic wave propagation it was found that there exist composite media exhibiting strong spatial dispersion. This has raised the question of the relevance of the spatial dispersion in the characterization of the new metamaterials. The present communication intends to show that exactly the same problematic occurs in acoustics when considering long-wavelength acoustic wave propagation in a fluid in presence of solid obstacles of any arbitrary shape. When these obstacles resemble "Helmholtz" resonators the macroscopic equivalent medium may exhibit strong spatial dispersion. It is demonstrated that the corresponding Macroscopic Acoustics, which may be worked out in detail, is very similar to the general nonlocal Maxwellian Macroscopic Electrodynamics. This raises the question of the relevance of the spatial dispersion in the characterisation of porous materials, and specifically the question of the possible design of acoustic metamaterials exhibiting enhanced absorption due to spatial dispersion.