ON A BOUNDARY LAYER PHENOMENON IN ACOUSTIC MEDIA

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ABSTRACT. In this work we describe a boundary layer phenomenon which occurs inside the atmosphere of the sun. As an application we derive new approximate boundary conditions. The boundary layer phenomenon which occurs in this context is rather close to the so-called skin effect phenomenon in electromagnetism [1, 2].

We investigate a transmission problem which is modeling the propagation of an acoustic wave inside heterogeneous media and in time-harmonic regime. This problem is set in a domain which represents the sun and its atmosphere. The specific feature of this problem lies in the presence of a small parameter δ which represents the inverse rate of the exponential decay of the density inside the atmosphere. This problem is well suited for the notion of equivalent conditions and the effect of the atmosphere on the sun is as a first approximation local.

First we present a multi-scale expansion in power series of δ for the solution u of the problem. Then we derive equivalent conditions up to the fourth order of approximation with respect to δ for the solution u. This approach leads to solve only equations set inside the sun. We present numerical results and numerical validations to illustrate the accuracy of the asymptotic models.

Keywords: Boundary layers, Heterogeneous acoustic media, Asymptotic expansion, Equivalent boundary conditions

Mathematics Subject Classifications (2010): 34E05, 34E10, 58J37

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