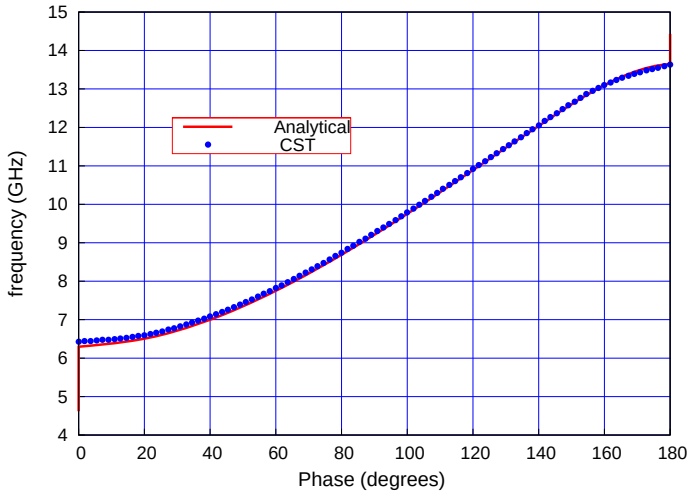

Fig. 6. Brillouin diagram for the first transmission band of an infinite periodic structure (1-D photonic crystal) with the same unit cell as that used in the finite structure considered in Table 1. Numerical results were generated using the commercial software CST [23].

6. Conclusion

This work has shown that the study of the wave propagation along stacked metallic grids separated by dielectric slabs can be carried out analytically with negligible computational effort making use of a simple circuit model. The circuit model remains valid even at frequencies for which the closed-form expressions that account for the influence of the grids are not valid; although in such a case better estimations of grid impedances are required. The main characteristics of the transmission bands (frequencies of the lower and upper resonances) are directly related to the behavior of the infinite 1-D periodic photonic crystal resulting from the use of an infinite number of unit cells. In this case the transmission bands and the band-gaps are accurately determined by means of circuit concepts and textbook analysis methods. The model is valid in the non-diffracting frequency region, far apart from the onset of the first grating lobe.

Acknowledgments

This work has been supported by the Spanish Ministerio de Ciencia e Innovación and European Union FEDER funds (projects TEC2007-65376 and Consolider Ingenio 2010 CSD2008-00066), and by the Spanish Junta de Andalucía (project TIC-4595). Francisco Medina would like to acknowledge the financial support from Spanish Ministerio de Ciencia e Innovación (mobility grant PR09-0405) during his stay at Queen Mary University of London, under supervision of Prof. Yang Hao. Alastair Hibbins and Celia Butler would like to acknowledge the financial support of the EPSRC (UK) and QinetiQ for supporting this work through APH's Advanced Research Fellowship and CAMB's Industrial CASE studentship.

#125055- $15.00USD Received4 Mar 2010;revised26 May 2010;accepted4 Jun2010;published7 Jun201C