# Abstract

This thesis deals with developing of electromagnetic eigenvalue solvers for periodic structures. Such solvers are capable to find any electromagnetic field configurations which may exist in the structure, called also modes. Since periodic structures are infinite in size, these solutions may only be obtained by including the periodicity in the numerical analysis approach and reduce the computational domain to a single region with periodic boundaries. Then, solutions are obtained as wave-vector frequency pairs where modes may exist. However, much of current research uses tools which may only obtain solutions for propagating modes, which means that for lossless structures, only real-valued wave-vector solutions can be obtained.

Therefore, we focus on solving the periodic eigenvalue problems with approaches which allow us to obtain also the evanescent modes. Such solutions are especially useful if the periodic elements are used to block the propagation of waves in undesired directions, as they allow us to understand the effectiveness of different geometries for this task and their dependence on the angle of incidence.

Our main focus is on structures which are glide-symmetric: in addition to the structure being periodic, it is also invariant with respect to a translation by half of a period and a mirroring. Such structures were recently a topic of intense investigation due to their excellent electromagnetic properties. Since the structures possess glide symmetry, the techniques developed here may include this property in the modelling procedure, increasing the speed of simulation. We make use of two distinct techniques: one based on the method of moments, and one on the multi-modal transfer matrix method.

This thesis is split in six chapters, including the four chapters with main contributions of this work. In the first chapter, we describe the background and motivation for this work. In the second chapter, we describe the appropriate irreducible Brillouin zone definitions for glide-symmetric structures. In the third chapter, we present the method of moments modelling with a novel Green's function. In the fourth chapter, we present preliminary results of developing an efficient matrix interpolation algorithm for use with periodic method of moments problems. In the fifth chapter, we develop the multi-modal transfer matrix approach for periodic structures in a hexagonal lattice. The conclusions of this work are given in the sixth chapter.