Analysis of diffraction from echelette gratings, using a strip-current model

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A method is presented for analyzing electromagnetic scattering from an echelette grating separating two contrasting homogeneous media and illuminated by a plane wave. The reduction of the general problem to a consideration of the fields over a suitably selected period, referred to as the unit cell, is facilitated by the Floquet theorem. The solution, in the *p*-polarization case (electric field parallel to the grooves), uses sets of spatially periodic and properly modulated fictitious electric-current strips to simulate the field scattered by the grating boundary surface and the field penetrated through the surface. In the *s*-polarization case (magnetic field parallel to the grooves), which is not examined in this paper, sets of fictitious magnetic-current strips, instead of electric ones, should be used. The fields radiated by the current strips are expressed in terms of Floquet modes and are adjusted to fit the continuity conditions for the tangential components of the electric and magnetic fields at a finite number of points on the grating surface within the unit cell. Special attention is given to the behavior of the fields at the corners. The procedure is simple to perform and is applicable to gratings of arbitrary cross section. Perfectly conducting gratings are treated as reduced cases of the general procedure. Results are given and compared with existing data. The efficiency of the suggested method is demonstrated.