

# *Gratings: Theory and Numeric Applications*

ed. E. Popov (Institut Fresnel, CNRS, AMU, 2012)  
ISBN: 2-85399-860-4

## **D. Maystre and E. Popov, Chapter 4: Integral method for gratings**

### **Table of Contents:**

4.1. Introduction	4.1
4.2. The integral method applied to a bare, metallic or dielectric grating.	4.2
4.2.1. The physical model	4.2
4.2.2. The boundary value problem.	4.3
4.2.3. Integral equation	4.4
4.3. The bare, perfectly conducting grating	4.7
4.3.1. Perfectly conducting gratings in TE polarization	4.7
4.3.2. Perfectly conducting gratings for TM polarization	4.8
4.4. Multiprofile gratings	4.9
4.4.1. Thin-layer gratings	4.10
4.4.2. Profiles without interpenetration	4.12
4.5. Gratings in conical mounting	4.14
4.6. Numerical tools for an efficient numerical implementation	4.15
4.6.1. Integration schemes for the integral equation	4.15
4.6.2. Summation of the kernels	4.18
4.6.3. Integration of kernel singularities	4.21
4.6.4. Kernel singularities for highly conducting metals	4.22
4.6.5. Problems of edges and non-analytical profiles	4.24
4.7. Examples of numerical results	4.27
4.7.1. Sinusoidal perfectly conducting grating	4.28
4.7.2. Echelette perfectly conducting grating	4.28
4.7.3. Lamellar perfectly conducting grating	4.29
4.7.4. Aluminum sinusoidal grating in the near infrared	4.30
4.7.5. Buried echelette silver grating in the visible.	4.30
4.7.6. Dielectric rod grating.	4.31
4.7.7. Flat perfectly conducting rod grating	4.32
Appendix 4.A: Mathematical bases of the integral theory	4.33
4.A.1. Presentation of the mathematical problem	4.33
4.A.2. Calculation of the Green function	4.33
4.A.3. Integral expression	4.34
4.A.4. Equation of compatibility	4.36
4.A.5. Generalized compatibility	4.39
4.A.6. Normal derivative of a field continuous on S.	4.42
4.A.7. Limit values of a field with continuous normal derivative on S.	4.44
4.A.8. Calculation of the amplitudes of the plane wave expansions at infinity.	4.45
Appendix 4.B : Integral method leading to a single integral equation for bare, metallic or dielectric grating	4.47
4.B.1. Definition of the unknown function	4.47
4.B.2. Expression of the scattered field, its limit on S and its normal derivative	4.48
4.B.3. Integral equation	4.49