Design and Correction of Optical Systems

Lecture 0: Introduction
2018-04-09
Herbert Gross
Overview

- Time: Monday, 12.15 – 13.45
- Location: Auditorium, Beutenberg campus
- Web page on IAP homepage under 'learning/materials' provides slides, exercises, solutions, informations
- Seminar: Repetition, questions, exercises and solutions of given problems
time: Monday, 14.15 -15.45, 2-weekly
Auditorium, ACP, Beutenberg
starting date: 2018-04-16
Mentor: Danyun Cai, Yi Zhong
For acceptance to the exam: at least one exercise in the seminar must be presented
- Shift of some dates could be possible
- Written examination, 90'
  Retake oral
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>09.04</td>
<td>Basics</td>
<td>Law of refraction, Fresnel formulas, optical system model, raytrace, calculation approaches</td>
</tr>
<tr>
<td>2</td>
<td>16.04</td>
<td>Materials and Components</td>
<td>Dispersion, anormal dispersion, glass map, liquids and plastics, lenses, mirrors, aspheres, diffractive elements</td>
</tr>
<tr>
<td>3</td>
<td>23.04</td>
<td>Paraxial Optics</td>
<td>Paraxial approximation, basic notations, imaging equation, multi-component systems, matrix calculation, Lagrange invariant, phase space visualization</td>
</tr>
<tr>
<td>4</td>
<td>30.04</td>
<td>Optical Systems (subs/shift)</td>
<td>Pupil, ray sets and sampling, aperture and vignetting, telecentricity, symmetry, photometry</td>
</tr>
<tr>
<td>5</td>
<td>07.05</td>
<td>Geometrical Aberrations</td>
<td>Longitudinal and transverse aberrations, spot diagram, polynomial expansion, primary aberrations, chromatical aberrations, Seidels surface contributions</td>
</tr>
<tr>
<td>6</td>
<td>14.05</td>
<td>Wave Aberrations (subs/shift)</td>
<td>Fermat principle and Eikonal, wave aberrations, expansion and higher orders, Zernike polynomials, measurement of system quality</td>
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<tr>
<td>7</td>
<td>28.05</td>
<td>PSF and Transfer function</td>
<td>Diffraction, point spread function, PSF with aberrations, optical transfer function, Fourier imaging model</td>
</tr>
<tr>
<td>8</td>
<td>04.06</td>
<td>Further Performance Criteria</td>
<td>Rayleigh and Marechal criteria, Strehl definition, 2-point resolution, MTF-based criteria, further options</td>
</tr>
<tr>
<td>9</td>
<td>11.06</td>
<td>Optimization and Correction</td>
<td>Principles of optimization, initial setups, constraints, sensitivity, optimization of optical systems, global approaches</td>
</tr>
<tr>
<td>10</td>
<td>18.06</td>
<td>Correction Principles I</td>
<td>Symmetry, lens bending, lens splitting, special options for spherical aberration, astigmatism, coma and distortion, aspheres</td>
</tr>
<tr>
<td>11</td>
<td>25.06</td>
<td>Correction Principles II (subs/shift)</td>
<td>Field flattening and Petzval theorem, chromatical correction, achromate, apochromate, sensitivity analysis, diffractive elements</td>
</tr>
<tr>
<td>12</td>
<td>02.07</td>
<td>Optical System Classification</td>
<td>Overview, photographic lenses, microscopic objectives, lithographic systems, eyepieces, scan systems, telescopes, endoscopes</td>
</tr>
<tr>
<td>13</td>
<td>09.07</td>
<td>Special System Examples</td>
<td>Zoom systems, confocal systems</td>
</tr>
</tbody>
</table>
1. Saleh / Teich  
   Fundamental of Photonics, Wiley 2007
2. Malacara  
   Geometrical and Instrumental Optics, Academic Press 1988
3. Mahajan  
   Optical Imaging and Aberrations
   Part II : Wave Diffraction Optics, SPIE 2001
4. Mouroulis/McDonald  
   Geometrical Optics and Optical Design  
   Oxford 1997
5. Welford  
   Aberrations of Optical Systems, Hilger 1986
6. Fischer/Tadic-Galeb  
7. Malacara/Malacara  
   Handbook of Lens Design, Dekker 2013
8. Kingslake/Johnson  
   Fundamentals of optical design
9. Laikin  
   Lens Design, Dekker 2007
10. Smith  
    Modern Optical Engineering, Graw Hill 2000
11. Geary  
    Lens Design with practical Examples, Willmann-Bell
12. Goodman  
    Introduction to Fourier Optics, Wiley 2005