# Table of Contents

## Preface

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Basic Image Handling and Processing</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Local Image Descriptors</td>
<td>29</td>
</tr>
<tr>
<td>3.</td>
<td>Image to Image Mappings</td>
<td>53</td>
</tr>
<tr>
<td>4.</td>
<td>Camera Models and Augmented Reality</td>
<td>79</td>
</tr>
</tbody>
</table>

### 1. Basic Image Handling and Processing

1.1 PIL—The Python Imaging Library | 1
1.2 Matplotlib | 3
1.3 NumPy | 7
1.4 SciPy | 16
1.5 Advanced Example: Image De-Noising | 23
Exercises | 26
Conventions for the Code Examples | 27

### 2. Local Image Descriptors

2.1 Harris Corner Detector | 29
2.2 SIFT—Scale-Invariant Feature Transform | 36
2.3 Matching Geotagged Images | 44
Exercises | 51

### 3. Image to Image Mappings

3.1 Homographies | 53
3.2 Warping Images | 57
3.3 Creating Panoramas | 70
Exercises | 77

### 4. Camera Models and Augmented Reality

4.1 The Pin-Hole Camera Model | 79
4.2 Camera Calibration | 84
4.3 Pose Estimation from Planes and Markers | 86
4.4 Augmented Reality | 89
Exercises | 98