

# Contents

<b>Preface</b>	<b>vii</b>
<b>1 Introduction</b>	<b>1</b>
<b>2 Physics-Based</b>	<b>5</b>
2.1 Cast Shadows	6
2.2 Attached Shadows	23
2.3 Shadow (Pen)umbra	34
2.4 Specularities	41
2.5 Lighting	56
2.6 Reflections	62
<b>3 Geometric</b>	<b>73</b>
3.1 Vanishing Points	74
3.2 Planar Rectification	85
3.3 Measuring Distance	101
3.4 3-D Modeling	109
<b>4 Optical</b>	<b>119</b>
4.1 Efficiency	120
4.2 Lens Distortion	131
4.3 Lens Flare	144
<b>5 Sensor</b>	<b>153</b>
5.1 Color Filter Array	154
5.2 Sensor Noise	165
5.3 Photo Response Non-Uniformity	178

<b>6</b>	<b>File</b>	<b>187</b>
6.1	Metadata	188
6.2	JPEG Quantization	193
6.3	Thumbnails	199
6.4	JPEG Markers	210
<b>7</b>	<b>Pixel</b>	<b>217</b>
7.1	Multi-JPEG Compression	218
7.2	Cloning	233
7.3	Re-sampling	246
<b>8</b>	<b>Case Studies</b>	<b>267</b>
8.1	Golden Eagle Snatches Kid	268
8.2	Footballer Momentarily Shrunk	271
8.3	The Lee Harvey Oswald Backyard Photo	275
<b>9</b>	<b>Background</b>	<b>285</b>
9.1	Bayesian Estimation	286
9.2	Convolution	291
9.3	Discrete Cosine Transform	294
9.4	Expectation Maximization	296
9.5	Fourier Transform	300
9.6	Least-Squares	304
9.7	Perspective Projection	309
	<b>Bibliography</b>	<b>315</b>
	<b>Index</b>	<b>321</b>