

1. Record Nr.	UNINA9910830700603321
Autore	Gordeyev Stanislav
Titolo	Aero-optical effects : physics, analysis and mitigation. // Stanislav Gordeyev, Eric J. Jumper, Matthew R. Whiteley
Pubbl/distr/stampa	Hoboken, New Jersey : , : John Wiley & Sons, Inc., , [2023] ©2023
ISBN	1-119-03715-8 1-119-03706-9
Descrizione fisica	1 online resource (286 pages)
Collana	Wiley Series in Pure and Applied Optics
Disciplina	410.5
Soggetti	Optics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Intro -- Aero-Optical Effects -- Contents -- Acknowledgements -- 1 Introduction -- 1.1 Motivation for Revisiting Aero-Optics -- 2 Fundamentals -- 2.1 Wavefronts and Index of Refraction -- 2.2 Huygens' Principle -- 2.3 Basic Equations and Optical Path Difference -- 2.4 Linking Equation -- 2.5 Image at a Focal Plane (Far-field Propagation) -- 2.6 Far-field Intensity in the Presence of Near-field Distortions -- 2.6.1 Temporal Intensity Variation -- 2.7 Wavefront Components -- 3 Measuring Wavefronts -- 3.1 Interferometry Methods -- 3.2 Wavefront Curvature Methods -- 3.3 Gradient-based Wavefront Sensors -- 3.3.1 Shack-Hartmann Wavefront Sensor -- 3.3.1.1 Wavefront Reconstruction Algorithm -- 3.3.2 Malley Probe -- 3.3.3 SABB Sensor -- 3.4 Typical Optical Set-Ups -- 4 Data Reduction and Interpretation -- 4.1 Statistical Analysis -- 4.1.1 Temporal and Spatial OPDrms -- 4.1.2 Histograms and Higher-Moment Statistics -- 4.2 Spectral Analysis -- 4.2.1 Relation between the Deflection Angle Spectrum and the Wavefront Statistics -- 4.2.2 Dispersion Analysis -- 4.3 Modal Analysis -- 4.3.1 Zernike Functions -- 4.3.2 Proper Orthogonal Decomposition (POD) -- 4.3.2.1 Direct Method -- 4.3.2.2 Snapshot Method -- 4.3.3 Dynamic Mode Decomposition (DMD) -- 4.4 Cross-correlation-based Techniques -- 4.4.1 Local Convective Speeds -- 4.4.2 Multi-point Malley Probe Analysis -- 4.4.3 Spatially Varying 2-D Convective Velocity -- 5 Aperture Effects -- 6 Typical Aero-Optical

Flows -- 6.1 Scaling Arguments -- 6.2 Free Shear Layers -- 6.2.1 Shear-Layer Physics -- 6.2.2 Aero-Optical Effects -- 6.2.3 Historical Shear Layer Measurements in AEDC -- 6.2.4 Weakly Compressible Model -- 6.3 Boundary Layers -- 6.3.1 Model of Aero-optical Distortions for Boundary Layers with Adiabatic Walls -- 6.3.2 Angular Dependence -- 6.3.3 Finite Aperture Effects. 6.3.4 Nonadiabatic Wall Boundary Layers -- 6.3.5 Instantaneous Far-Field Intensity Drop-Outs -- 6.3.5.1 Absolute SR Threshold -- 6.3.5.2 Relative Intensity Variation -- 6.4 Turrets -- 6.4.1 AAOL -- 6.4.2 Flow Topology and Dynamics -- 6.4.3 Steady-lensing Effects at Forward-looking Angles -- 6.4.4 Aero-optical Environment at Back-looking Angles -- 6.4.5 Shock-effects at Transonic Speeds -- 7 Aero-Optical Jitter -- 7.1 Local and Global Jitter -- 7.1.1 Local Jitter -- 7.1.2 Global Jitter -- 7.2 Subaperture Effects -- 7.3 Techniques to Remove the Mechanically Induced Jitter -- 7.3.1 Cross-correlation Techniques -- 7.3.2 Large-Aperture Experiments -- 7.3.3 Stitching Method -- 8 Applications to Adaptive Optics -- 8.1 Beam-Control Components -- 8.2 How Much Correction Is Needed -- 8.3 Flow-Control Mitigation -- 8.3.1 Non-Flow-Control Mitigation -- 8.3.2 Some Qualities of Separated Shear Layers -- 8.3.3 Using the POD Analysis to Develop Requirements -- 8.4 Proper Number of Wavefront Sensor Subapertures to Actuator Ratio -- 8.4.1 Numerical Simulation -- 8.4.2 Simulation Results -- 8.4.3 Conclusion from the Simulation Results -- 9 Adaptive Optics for Aero-Optical Compensation -- 9.1 Analogies from Free-Stream Turbulence Compensation -- 9.1.1 Statistical Optics Theoretical Considerations -- 9.1.2 Power-Law Observations from Aero-Optical Wavefront Data -- 9.2 Compensation Scaling Laws for Aero-Optics -- 9.2.1 Adaptive Optics Control Law and Error Rejection Transfer Function -- 9.2.2 Asymptotic Results for Aero-Optics Compensation -- 9.2.3 Aero-Optics Compensation Frequency -- 9.2.4 Relation of Aero-Optics Scaling Laws to Free-Stream Turbulence -- 9.3 Spatial and Temporal Limitations of Adaptive Optics -- 9.3.1 Framework for Analysis of Aero-Optical Compensation -- 9.3.2 Deformable Mirror Fitting Error for Aero-Optical POD Modes. 9.3.3 Decomposition of Correctable and Uncorrectable Power Spectrum -- 9.3.3.1 DM Sensitivity Transfer Function -- 9.3.4 Closed-Loop Residual Wavefront Error -- 9.3.5 Effect of Latency in Aero-Optics Compensation -- 9.4 Application to System Performance Modeling -- 9.4.1 Scaling of Aero-Optical Statistics to Flight Conditions -- 9.4.2 Joint Variations in Adaptive Optics Bandwidth and Actuator Density -- 9.4.3 Relative Impact of Aero-Optics with Other Propagation and System Effects -- 9.4.3.1 Comparing Aero-Optics to Free-Stream Turbulence Propagation -- 9.4.3.2 Comparing Aero-Optics to System Optical Jitter -- 9.4.4 Tracker Performance Degradations Related to Aero-Optics -- 9.4.4.1 Track Sensor Aero-Optical Imaging Resolution Degradation -- 9.4.4.2 Illuminator Propagation and Active Imaging through Aero-Optics -- 10 Concluding Remarks -- References -- Index -- EULA.
