



Workshop COAT 2019

COAT 2019

Communications and Observations through Atmospheric Turbulence: characterization and mitigation



TOPICS

- Atmospheric Turbulence
- Modeling, Prediction and Mitigation
- Adaptive Optics, Wave-Front Sensing
- Control, Signal Processing

SOC • Géraldine Artaud (CNES) • Olivier Meyer (DGA) • Ramon Mata-Calvo (DLR)
James Osborn (Durham Univ.) • Szymon Gladysz (Fraunhofer IOSB)
Aniceto Belmonte (Technical Univ. of Catalonia) • Anne Durécu (ONERA)
Jean-Marc Conan (ONERA) • Clélia Robert (ONERA) • Laurent Mugnier (ONERA)

2-3 December 2019 • Châtillon, France

<https://www.onera.fr/coat2019>

ONERA
THE FRENCH AEROSPACE LAB

29 avenue de la Division Leclerc - FR-92322, CHATILLON
Metro 13 "Châtillon Montrouge" + Tram T6 to "Parc André Malraux"
<https://www.onera.fr/en/centers/chatillon>



DETAILED PLANNING & SCIENTIFIC PROGRAM

DAY 1 : MONDAY DEC, 2nd

8:30 : Welcome & Coffee

9:15 : Introduction

9:30 : Morning Session

I. Atmospheric turbulence: modeling, characterization & prediction [Chair: Ramon Mata-Calvo (DLR)]

1. **9:30** Sukanta Basu (Delft University of Technology, Netherlands) *Mesoscale Modelling of Optical Turbulence in the Atmosphere: Quantifying the Impact of Ultra-High Vertical Resolution*
2. **9:50** Clélia Robert et al. (ONERA, France) *Modelling the C_n^2 and wind profiles for space-ground optical links with parametric models: cross-comparison with mesoscale models and in-situ measurements*
3. **10:10** James Osborn (Durham Univ., UK) *Measuring, modelling and forecasting the dynamics of the Earth's optical turbulence for optical communications between the ground and space*

10:40 Coffee Break (30 min)

II. Impact of turbulence on beam propagation [Chair: Marie-Thérèse Velluet (ONERA)]

4. **11:10** Mikhail Vorontsov (Dayton Univ., USA) *The Extended-Range Comprehensive Atmospheric Optics Sensing (ERCAOS) Campaign: Overview*
5. **11:30** Olga Korotkova (University of Miami, USA) *Polarimetry of the Clear-Air Optical Channels: Example of a Mono-static System*

12:00 : Lunch & Poster Session (duration 2 hours 20 min) [see poster list on page 3]

14:20 : Afternoon Session

III. Adaptive optics for space observation [Chair: Thierry Fusco (ONERA)]

6. **14:20** Pierre-Yves Madec (ESO) *Adaptive Optics Facility – when cutting-edge technology meets operational robustness and performance*
7. **14:40** Cyril Petit et al. (ONERA, France) *Adaptive Optics assisted LEO satellite imaging*
8. **15:00** Baptiste Siquin et al. (IOGS, France) *Data-based modelling of low-order modes for AO control: what do on-sky experiments tell us?*

15:20 Coffee Break (45 min)

IV. Novel turbulence mitigation strategies (1/2) [Chair: Laurent Lombard (ONERA)]

9. **16:05** Mikhail Vorontsov (Dayton Univ., USA) *Laser Beam Engineering and Atmospheric Turbulence Effects Mitigation with Coherent Fiber Array Systems*
10. **16:35** Szymon Gładysz (Fraunhofer Institute of Optronics, IOSB, Germany) presents: Max Segel et al. *Modal Wavefront Sensorless Adaptive Optics with Karhunen–Loève Functions*
11. **16:55** Carlos E. Carrizo et al. (Technical Univ. of Catalonia, Spain) *Laboratory Validation of Sequential Optimization of Adaptive Receivers in Downlink Laser Communications*

17:15 Practical information for Social Event and second day (5 min)

17:20 : End of Afternoon Session

20:15 : Social Event meeting @ "Ile aux Cygnes, Middle of the Bridge of Bir-Hakeim, Paris 15e"

Metro : M6 Bir Hakeim or RER C Champ de Mars - Tour Eiffel

<https://www.lecapitainefracasse.com/en/acces-croisiere/>

DAY 2 : TUESDAY DEC, 3rd

9:00 : Welcome & Coffee

9:30 : Morning Session

IV. Novel turbulence mitigation strategies (2/2) [Chair: Nicolas Védrenne (ONERA)]

1. **9:30** Aniceto Belmonte et al. (Technical Univ. of Catalonia, Spain) *Optimal modal basis approaches fundamental limits to free-space optical system capacity imposed by atmospheric turbulence*
2. **9:50** David Allieux (CAILABS, France) presents: Antonin Billaud et al. *Pointing Error Compensation For Laser Communication Using Multi-Plane Light Conversion Spatial Demultiplexer*

10:10 Coffee Break (40 min)

V. Ground-space optical links: concepts and applications (1/2) [Chair: Géraldine Artaud (CNES)]

3. **10:50** Eleni Diamanti (LIP6, Sorbonne Univ., France) presents: Daniele Dequal et al. *Feasibility of satellite-to-ground continuous-variable quantum key distribution*
4. **11:10** Arnaud Le Kernec et al. (TAS, France) *Optical feeder links for high throughput satellites*
5. **11:30** Sylvain Poulenard (ADS, France) *Protection schemes for optical communication between optical ground station and satellite*

12:00 : Lunch (duration 1 hour 30 min)

13:30 : Afternoon Session

V. Ground-space optical links: concepts and applications (2/2) [Chair: Aniceto Belmonte (TU Catalonia)]

6. **13:30** Jean-Marc Conan et al. (ONERA, France) *Adaptive optics for GEO-Feeder links: analysis of point ahead anisoplanatism impact via reciprocity based models*
7. **13:50** Matthew J. Townson et al. (Durham Univ., UK) *Retrieving Tip/Tilt from Laser Guide Stars with the LATTE Experiment*

VI. Free space communication links: experimental demonstrations [Chair: Olivier Meyer (DGA)]

8. **14:10** Andrew Reeves (DLR, Germany) *Demonstrations of optical free space communications through turbulence relevant to geostationary feeder-links*
9. **14:40** Aurélie Montmerle-Bonnefois et al. (ONERA, France) *FEDELIO : demonstrating the feasibility of adaptive optics compensated GEO feeder links*
10. **15:00** Andrew Lambert et al. (UNSW Canberra, Australia) *Experiments in Free Space Laser Communications*

15:20 : Discussion & Concluding remarks (duration 30 min)

15:50 : Closing with Coffee Break !

POSTERS [Poster Session on DAY1 Monday Dec., 2nd; 12:00 to 14:20]

I. Atmospheric turbulence: modeling, characterization & prediction

1. Alexander Knoedler and Florian Moll (DLR, Germany) *Atmospheric Turbulence Statistics Local to DLR Oberpfaffenhofen*
2. Frédéric Jabet (MIRATLAS, France) *Short term prediction of atmospheric metrics from the data delivered by a network of autonomous sensors through machine learning*
3. Andrew Lambert et al. (UNSW Canberra, Australia) *Turbulence Characterisation at La Palma using SLODAR*
4. David-Tomline Michel et al. (ONERA, France) *Characterization of small-scale atmospheric wind-field structures using coherent wind lidar with short pulses*

II. Impact of turbulence on beam propagation

5. Nurdan Anılmiş Bacı (National Research Institute of Electronics and Cryptology, Turkey) *Modelling Wave-front Aberrations of Laser Beams Travelling through the Atmospheric Turbulence*
6. Melissa Beason et al. (University of Central Florida, USA) *Using Statistics to Compare the Fit of Probability Density Functions of Intensity Fluctuation*
7. Laurent Lombard et al. (ONERA, France) *Beam combining of 7 fibers using a multiplane light converter*

IV. Novel turbulence mitigation strategies

8. Luca Rinaldi et al. (ONERA, France) *Coupling of atmospheric perturbed optical beams with guided modes of propagation*
9. Judith Dijk (TNO, Netherlands) presents: Nicolas Boehrer et al. *Using event cameras for imaging through atmospheric turbulence*

V. Ground-space optical links: concepts and applications

10. Laurie Paillier et al. (ONERA, France) *Adaptive optics assisted space-ground coherent optical links: impact of turbulence on carrier recovery*

VI. Free space communication links: experimental demonstrations

11. Matteo Schiavon et al. (Padova Univ, Italy) *Experimental characterization of an urban free-space fiber-to-fiber optical link for quantum key distribution*
12. Chloé Sauvage et al. (ONERA, France) *Dynamic and environmental study of a mid infrared wavelength channel for a horizontal telecom link*
13. Bruno Martin et al. (ALPAO, France) *ACE fast: Real-Time Computing Framework for AO Closed-Loop Control*