# Caroline Lim - Adaptive optics for free-space optical links

# Rapport sur les contributions

ID de Contribution: **1** Type: **Non spécifié**

# Adaptive optics for free-space optical links

*jeudi 15 septembre 2022 11:00 (1h 15m)*

Optical wavelengths are an alternative to radio-frequency and are seen today as a key technology for free-space links. The use cases are various, we will focus in particular on payload data transfer from LEO satellites (downlinks), communication with GEO satellites (bidirectional links), and satellite-based quantum key distribution. On the ground segment, the use of single-mode fiber components, and thus the coupling of the propagating signal into a single-mode fiber, is often favored. However, the coupling efficiency can be strongly hampered by the turbulence-induced phase distortions and amplitude fluctuations (called "scintillation"). Adaptive optics can provide a real-time compensation of the phase distorsions and have been identified as a key solution, as illustrated in this presentation. We first show an experimental demonstration of a LEO-to-ground optical link, with single-mode fiber coupling on the ground assisted by adaptive optics, carried out in 2018. Then we present the FEEDELIO experiment, performed in 2019, and which consisted in a demonstration in a relevant environment of pre-compensation by adaptive optics for GEO bidirectional links. The discussion includes a brief focus on the impact of anisoplanatism, and on the impact of scintillation and of non-common path aberrations. Last, we present a feasibility study of satellite-to-ground quantum key distribution accounting for different turbulence conditions, and quantifying the gain possibily brought by adaptive optics to the key rate performance.

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