University
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Visibility measurement using digital camera

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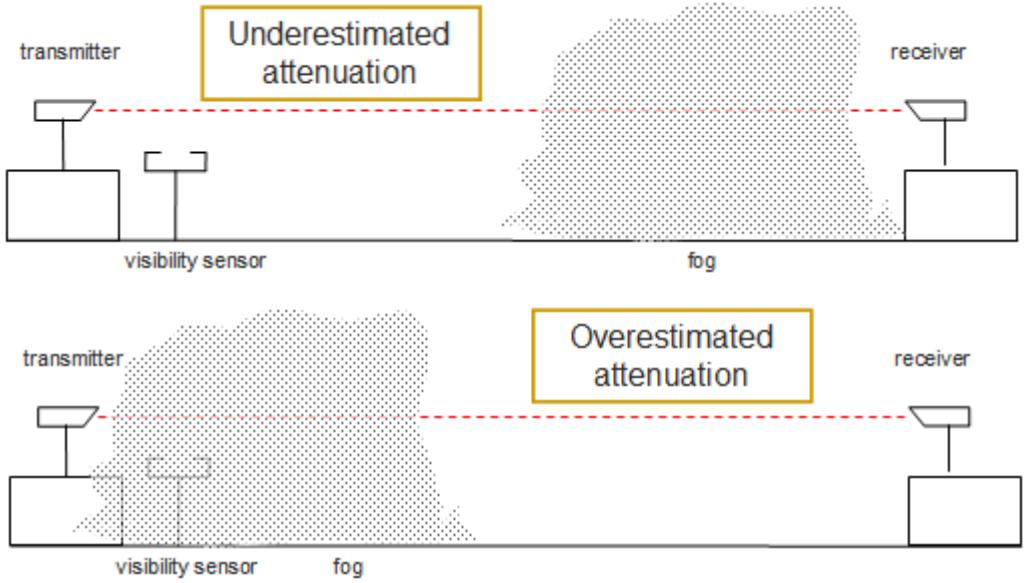
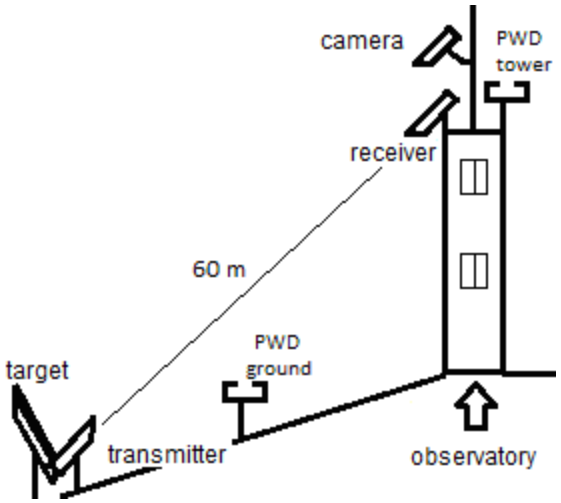
INTRODUCTION

- Visibility is a quantity describing density of fog and clouds which have the highest impact on Free Space Optical (FSO) link transmission
- Based on our experience we know that fog or clouds can be very inhomogeneous even in short distances.
- Professional visibility sensors provide only point measurement
- Modeling of FSO link attenuation from visibility is then distorted



OBJECTIVES

To develop a device for measuring the visibility between two given points (receiver and transmitter of the optical link).



Experimental optical link at Milesovka observatory

MATERIAL & METHOD

- Camera measures the contrast between black and white parts of the target
- Formula for visibility based on Beer-Lambert law:

$$V = \frac{\ln(0.02)}{\ln\left(\frac{C}{C_0}\right)}.x$$

x …. distance between the camera and the target
C_0 … Intrinsic contrast of the target (measured close to it)
C …. Contrast measured from distance x in possible reduced visibility

Contrast measured by camera:

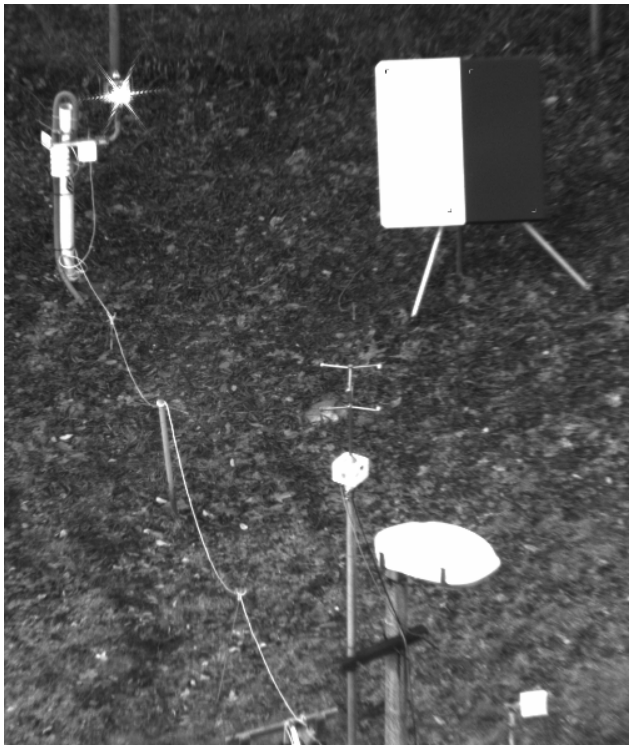
$$C = \frac{L_w - L_b}{L_w + L_b}$$

L_w, L_b … luminance of white and black parts

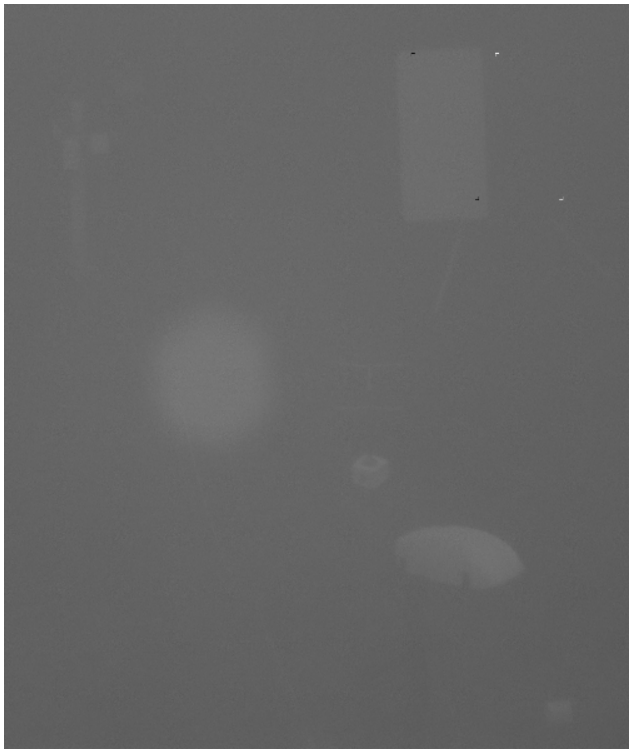
RESULTS

Examples measured by camera

Clear atmosphere – V = 20 km



Low cloudiness – V = 70 m
7.11.2012

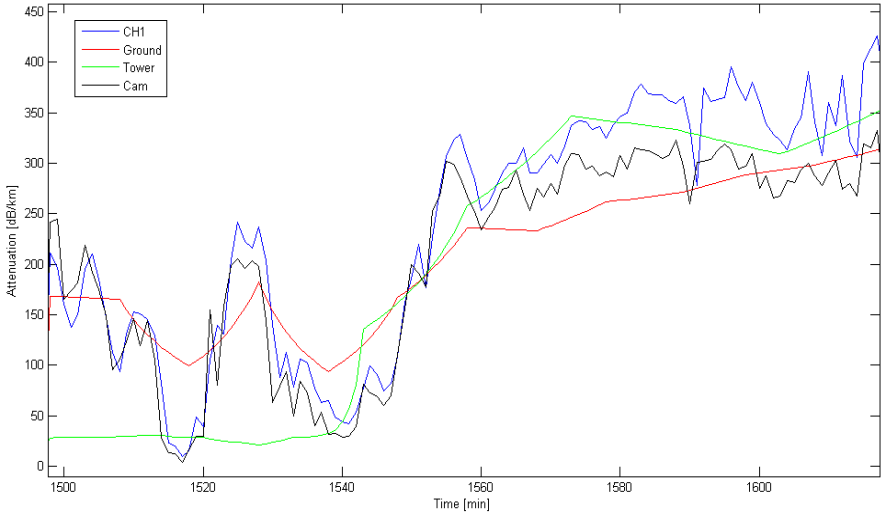


RESULTS

Comparison to professional visibility sensors

From the figure below we can see few advantages:

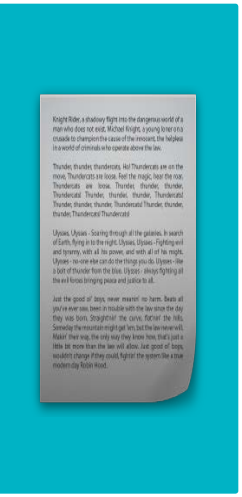
- PWD11 and PWD21 have a long measurement interval (10 and 15 min), camera can clearly record quick changes in visibility.
- There was the inhomogeneity of visibility in the first part of the time period. While professional sensors show distorted predictions, camera successfully follows the measured attenuation.



Measured optical attenuation at 1550 nm (blue), specific attenuations computed from

- visibility by PWD11 at the receiver (red)
- visibility by PWD21 at the transmitter (green)
- visibility by camera (black)

ACKNOWLEDGEMENT & CONTACT



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