Combination of Microwave and Optical Observations for minimizing Atmospheric induced variations in Parameter Estimation

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Atomic Clock Ensemble in Space (ACES) is an ESA future space mission, with focus on fundamental physics and time transfer. The basic configuration consists of a Microwave-LinkSystem (MWL) in space and ground, an optical detector and reflector, as well as a new generation of atomic clocks. To use their full fractional frequency stability and accuracy, all observation errors have to be minimized before post-processing. Especially electronic delays of MWL systems in transmitting and receiving are correlated with clock estimations. For that, the hardware will be pre-calibrated on ground, but there is no guarantee that the electronic delays of the system calibration will be static. Therefore, we develop a strategy to calibrate the MWL in downlink as well as in uplink direction. Due to the fact, that the official launch date is in 2025, there is a lack of real observation data. For that, we focus in our work first on near-realistic error simulation and afterwards on the calibration process. The developed simulation software, produces MWL code and phase observations in downlink and uplink, as well as one- and twoway laser observations. For calibration, we combine MWL- and optical-data in a Least-SquareAdjustment (LSA). Our studies show, that minimizing the atmosphere induced errors, is crucial for a proper hardware calibration. Assuming a common atmosphere for simultaneous optical and microwave observations, minimizes the tropospheric delay on the MWL observations sufficiently. We tested our calibration strategy with one month of simulation data, which corresponds to about 100 passes over a specific ground station. The delays could be estimated within sufficient accuracy, but there is still some space for improvements. Our further research will be focused on common troposphere estimation, as well as the impact of different observation weights on parameter estimation in LSA.