Recent progress in SPAD detectors for SLR and laser time transfer

Ivan Prochazka (1), Roberta Bimbova (1), Josef Blazej (1) and Jan Kodet (1,2)
(1) Czech Technical University in Prague, Brehova 7,115 19 Prague 1, Czech Republic; (2) Technische Universität München, Forschungseinrichtung Satellitengeodäsie, München, Germany

Our group is working on the development and improvement of existing Single Photon Avalanche Detectors (SPADs) for satellite laser ranging and laser time transfer applications. The existing SPAD detector package based on a 100um diameter Si-based SPAD chip, cooled by a single-stage TE cooler, is under improvement, intending to reduce its temperature dependency of a detection delay. We modified the ultrafast comparator and related signal logic to reduce the detection delay temperature dependence from original values exciting 250 fs/K down to a nearly linear dependence with a slope well below 100 fs/K. This detector package was optimized mainly for laser time transfer ground to space.

The new version of the infrared detector package based on the InGaAs/InP detection chip was developed and tested. It is based on a commercial chip. Its active area diameter is 80 um and is dedicated for 1064 nm wavelength only. Cooling is ensured by three stages thermoelectric cooler. We developed new active gating and active quenching circuit, which in connection with this chip guarantees the fixed detection parameters (sensitivity, jitter, detection delay) within a broad gate window. The detection chip is operated at 4.2 Volts above its breakdown voltage. The timing jitter is well below 60 ps rms. The detection delay is stable and reproducible for range gates up to 10 us wide. Its timing stability computed using Time Deviation TDEV is better than 300 fs for averaging times of hours.