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Jitter Analysis of Pulse-Per-Second Timing Signals Transmitted over Optical Fibre Networks

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The telescope networks rely on high frequency clock tones to be distributed to each antenna for driving the digitizers, time stamping the data, and for monitoring and control functions. Stringent timing signals also find use in organisations like Square Kilometre Array, National Metrology Institute of South Africa, Coordinated Universal Time and Global Positioning System; as well as in areas of financial systems, telecommunications, transport, military, etc. However, clocks suffer from time deviation from the true periodicity, known as jitter. Jitter is contributed by noise, thermal effects, aging, etc. It can be either random or deterministic. In this study we analyse the jitter contributed by transmission of pulse-per-second (PPS) timing signals over typical optical fibre networks. The PPS timing signals were transmitted in G.652 Optical fibre of 3.21 km. The 1310 nm Vertical Cavity Surface Emitting Laser, biased at 4.79 mA, was modulated using PPS signals. The overall jitter contribution from the optical fibre transmission was found to be 0.202 femtoseconds. This means that the PPS signals' periodicity deviates by this value, and may cause signal delays in communication and timing systems. However, this value agrees within the typical acceptable jitter ranges of pico- to femtoseconds. For stringent timing applications, jitter correction mechanisms may be required to effectively compensate for the jittery in such systems.
Keywords: Timing signals, PPS, Jitter, Optical fibre networks

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