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Towards the Development of VCSEL-Based Time and Frequency Dissemination System using a DFB Phase Error Correction Actuator for the SKA

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The Square Kilometre Array (SKA) will be an interferometric, ultrasensitive radio astronomy instrument with an aperture array of one million square metres. The SKA telescope array will be coherently connected using optical fibre across an area of approximately 3000 km. A crucial and complex requirement for the SKA antenna is the coherent combination of the incoming astronomical data collected by the individual receptors remotely located. With recent progress and improvements made in atomic frequency standards, optical fibre is an attractive medium for stable and highly accurate timing and frequency transfer between a centralized location and multiple end-users. Precise and accurate clock tones will be distributed via optical fibre to the digitizers located on each antenna, thereby providing phase coherence within the telescopes array network. Natural temporal variations and external environmental conditions can affect the phase stability of the optical signal transmitted along the fibre. For this reason, an active fibre based time and frequency stabilization system is required. In this paper, a 22 km fibre round trip experiment described using a DBF phase correcting actuator. A 248.78 ps phase correction is applied to a 2 GHz clock signal at the transmitting end. Phase error correction to the distributed optical signal is achieved by exploiting the wavelength tunability of a distributed feedback (DFB) laser. Our proposed system has potential application in big data projects such as the Square Kliometre Array and various other frequency dissemination applications. Such systems can be employed into metro-access telecommunication networks.

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Level for award
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PhD

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