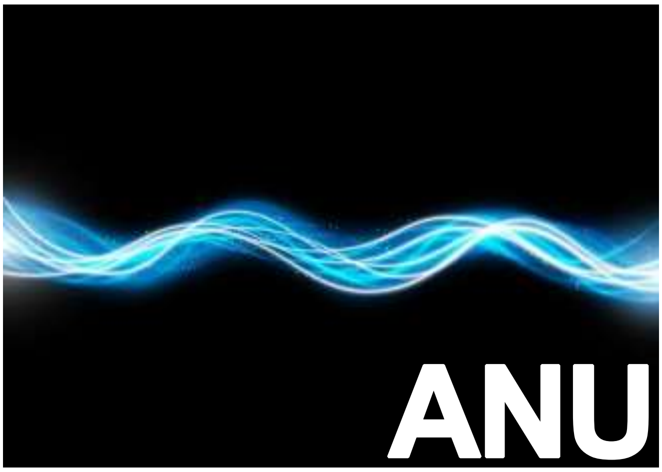
Australian National University

TECHNICAL SUMMARY

Time Differential Phase Recovery for Optical and RF phase measurement



Time Differential Phase Recovery (TDPR) is a real-time phase measurement algorithm designed for extracting useable phase measurements from RF signals, aimed at applications in RF and optical phase measurement. While it can operate on phase signals of any type, it excels in environments where the signal is weak relative to background noise, or if the signal is changing rapidly, and by large amounts. In these scenarios, we have demonstrated TDPR to maintain phase tracking while other methods (PLL, Arctangent) have degraded in performance or experienced cycle-slip events. The algorithm is designed for use on real-time digital signal processing hardware, such as FPGA systems. It is an open-loop architecture, requiring no feedback control.

Researchers at Australian National University (ANU) have recently made a breakthrough in this area by inventing an alternative method for phase recovery which is aimed at tracking weak and highly dynamic signals. In addition, it would address applications where significant investment in PLL design shall be required to achieve reliable measurements or maintain phase tracking.

Technology (TT2023-001)

The technique comprises of an algorithm designed to run at real-time speeds (FPGA/ASIC implementations). It takes inputs from the RF demodulation stage of a regular phase measurement architecture (analogous to the first stage of a PLL). From here, the inputs to the algorithm are split into two paths, with a time delay applied to one. While remaining in IQ space, the difference between the two paths is computed. This means that instead of recovering the phase of the entire signal, it recovers the phase of a time segment. The output integrates multiple time segments to recover the completed phase measurement.

Potential benefits

> **Main advantage:** Open-loop: highly stable, extremely high common mode suppression
> **Optical phased arrays:** This technology is aimed at tracking rapid phase shifts, such as those from noisy lasers leading to phase control and coherent combining of lower-cost lasers for directed energy applications
> **Distributed Acoustic Sensing (DAS):** Help in high precision measurements over longer measurement distances, work under constraints of rapidly changing dynamics and weak signals as seen in DAS systems.
> **Phase detection for Coherent Communications:** Provides a high-speed cycle-slip/noise resistant measurement of phase modulated communication channels (e.g PSK/DPSK/FSK protocols).

Potential applications

> Optical Interferometric Measurement
> RF Phase Measurement
> Weak signal measurement

Opportunity

ANU team is exploring opportunities with: 1) Application specific R&D partnerships – how can we work to develop DDPR into a specific product in an area, 2) Feedback from industry on broad applicability and interest is also useful.

IP status

The IP is owned by The Australian National University and the subject of a provisional patent.

Key research team

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