

**Electrical Engineering and Information Technology**

**Title:** Pulsed Sagnac Loop Phase Modulated RF Photonic Link

**UMD18-10**

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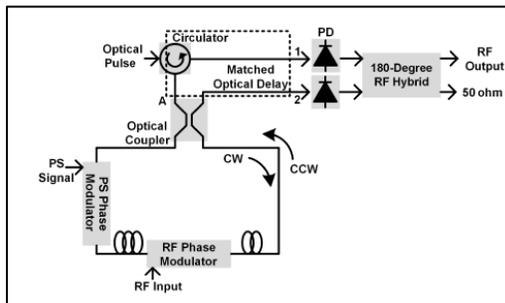
- Applications:**
- Antenna remoting
  - Radar front end
  - Optical analog-to-digital conversion
  - Radio-over-fiber link for 5G wireless communication antenna systems

- Benefits:**
- A phase modulated link with a pulsed optical source that can achieve an arbitrary phase offset to the two counter propagated optical waves.
  - The link shows a flat frequency response over 1 to 10GHz, which is limited to the bandwidth of the phase modulator.
  - The link demonstrated an output noise floor that is close to the shot noise floor, and a favorable SFDR due to the lower noise floor.

**Technology Description:**

Microwave photonic links, although desirable for transporting RF signals, often employ intensity modulation and direct detection (IM-DD), which can lead to laser relative intensity noise (RIN). In comparison, phase modulated (PM) microwave photonic links have lower insertion loss and can mitigate the laser RIN, but are extremely sensitive to environmental perturbation, hindering their wide adaptation. Sagnac loop topology has been widely adopted in optical gyros to mitigate random optical phase perturbation. However, the main obstacle of applying Sagnac loop to PM links is that its two optical paths (clockwise and counter-clockwise) are exactly identical and thus cancel each other out. The present invention solves this problem through a configuration that contains two in-loop optical phase modulators: one for signal modulation and the other for generating a non-reciprocal optical phase shift between the two optical paths. The optical pulse trains in the two propagation directions therefore experience different phase modulation and do not cancel each other out.

**Patent Status:** UMass Dartmouth has filed a provisional patent application on this invention. The invention is based on research published in [IEE Photonics Technology Letters](#) in March 2018.



Schematic drawing of the loop claimed in this invention

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