

### Optical Down-Conversion and Digital Processing of Microwave Signals

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**Abstract** – A combined optical and digital microwave signal processing scheme is considered for a radar receiver application. Frequency down-conversion is an essential element of microwave signal processing. Classical electronic down-conversion using heterodyne mixing, however, introduces unavoidable non-linearities resulting in inter-modulation distortion and conversion loss. In this paper we consider a coherent, phase modulated optical link comprised of an all-optical down-conversion scheme combined with digital (electronic) phase demodulation and signal processing. Theoretical results are presented showing that the optical domain down-conversion is free of distortion and conversion loss. Proof-of-concept experiments are also presented to show how the down-converted signals can be digitally demodulated and processed and a 23dB reduction of the third-order nonlinear spurious signal level was obtained. It is anticipated that with high precision A/Ds, an SFDR of 150 dB·Hz<sup>2/3</sup> or higher across a bandwidth of 1GHz can be obtained. The purpose of the study is to examine how a hybrid optical-digital approach can exceed the performance of a classical electronic technique.