
# Chaos-Based Photonic Information Processing platforms : Capabilities and Challenges

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# Chaos-Based Photonic Information- Processing Platforms: Capabilities and Challenges

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This contribution will provide an overview of developments in the use of chaotic semiconductor lasers to effect advanced information processing in the optical domain. The presentation will also consider the opportunities for delivering enhanced functionality using photonic integration.

The demonstration of chaos synchronisation in semiconductor lasers [1] stimulated a significant world-wide research effort directed at the implementation of secure optical communications systems [2]. Although efforts to develop such communications systems continue, the richness of optical chaos enables several other directions of development [3] and notably in physical means for random number generation []and reservoir computing. Results of our work in these two areas will be presented.

In respect of random number generation (RNG), we have made particular progress in the generation at multi-Gb/s data rates without the need for off-line post-processing [4-8] with Tb/s RNG being feasible [9]. Here we will point to outstanding challenges to achieving compact photonic RNG modules through photonic integration [10].

Chaotic semiconductor lasers are the work-horse device for so-called photonic reservoir computing. Our recent efforts on modulation format identification [11] and image recognition [12] using reservoir computing will be outlined and indications of directions for future development will be given.

Almost any semiconductor laser can be utilised in such technologies, but, VCSELs and nano-lasers have clear attractions for photonic integration. Our recent work has considered the opportunities for utilising polarisation chaos in stand-alone VCSELs for enhancing information processing capabilities [13]. Here a specific device challenge arises since the requisite behaviour is not a feature of commercially-available VCSELs.

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