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To satisfy the economic drive for ever more powerful computers to handle scientific, business, and social applications, new technologies are needed to overcome the limitations of current integrated circuit memory and processor technologies. A decade ago, the so-called reservoir computing (RC) has been proposed as a new approach of designing, training and analyzing Recurrent Neural Networks. Currently, most of the information is processed by photonic systems, therefore there is a strong need for the photonic-based implementation of RC, which is also called analog processor.

Main goal of the project is the demonstration of the system based on semiconductor lasers, which will be suitable for reservoir computing applications. The system will consist of electrically injected broad-area VCSEL pumped locally by external laser. We expect that such system will exhibit strong nonlinear response and regular behavior which meet the requirements of RC. The system will be designed using numerical methods supported by experimental measurements, several VCSEL wafers will be processed and RC systems will be assembled and comprehensively evaluated as possible analog processors.

Our choice of system is strongly motivated by the fact that VCSELs offer non-linear behaviors and a very short response time to an electrical and/or optical signal. Another novelty of this project is the utilization of spectral and spatial response of the VCSEL as the fundamental operation of the analog processor which allows for continuous signal transformation without necessity of sampling in the time domain of the input signal.