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Ph.D. DISSERTATION DEFENSE

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Title:	Photonic Reservoir Computing
Chairperson:	Dr. Yuping Huang, Department of Physics, School of Engineering & Sciences
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ABSTRACT

Photonic Reservoir Computing (PRC) is an exciting field of research that combines the advantages of optical systems with the principles of reservoir computing to perform complex computations. Reservoir computing systems consist of a dynamic nonlinear network (the reservoir) and a linear readout layer that maps the reservoir's states to the output. The beauty of this approach is that the reservoir can be any dynamical system with desired physical properties, and its dynamics need not be explicitly designed to perform the task.

One of the primary advantages of PRC is its ability to process high-dimensional data with high bandwidth. For example, it can be used to process large volumes of real-time audio or video data streams with relatively low power consumption. This makes PRC an attractive technology for applications such as speech recognition, image processing, and pattern recognition.

We developed a robust photonic reservoir computing system that can perform various tasks, including function fitting, prediction, and classification. We evaluated the system's performance using well-known benchmark datasets such as NARMA10, Mackey-Glass series, MNIST, and isolated spoken digit recognition. The results indicate that our system exhibits superior performance, achieving high accuracy rates, low error rates, and consistent performance across a wide range of tasks and datasets, thus demonstrating its robustness and versatility.

PRC has already shown significant promise in various real-world applications. It has been shown to be particularly effective in solving nonlinear problems, such as those encountered in chaotic time-series prediction. As PRC continues to develop, it is likely to find applications in a broad range of fields, including communications, finance, and healthcare.