# Software Architecture and Support for Image Processing Using Controllers with Graphic Processing Units

**Department of Computer Science** **University of North Carolina at Chapel Hill** **August 2014**

## The Challenge

Advanced driver assistance systems (ADAS) and autonomous automobiles are quickly emerging technologies with the potential to revolutionize transportation. Early proof-of-concept vehicles of the last decade were unconstrained by issues of size, weight, power, reliability, or even cost. However, each of these concerns must be addressed directly as these technologies mature into the mainstream.

Core to these advanced automotive systems is how the vehicle senses its environment. Early research has taught us that an effective suite of sensors, such as video cameras, radar, and lidar, collectively generate data on the order of hundreds of megabytes per second. A vehicle's onboard computer systems must process this data immediately to safely navigate through, and react to, its environment. Traditional processors (e.g., CPUs) are unable to meet the computational requirements of such a workload within the size, weight, power, and cost constraints of a mainstream vehicle. Fortunately, sensor-processing algorithms are characterized by data-parallelism. Thus, non-traditional processors, specifically graphics processing units (GPUs), that are optimized for data-parallelism may offer the necessary computational power within size, weight, power, and cost constraints. However, how to use GPUs reliably, especially in terms of scheduling and effective software architectures, remains an open area of research.

## The Approach

In this research, we will identify those hardware platforms that are best suited for use in advanced automotive system embedded environments. We will survey hardware available today, weigh the pros and cons of each platform, and make recommendations on those best suited for automotive applications. On at least one of these recommended platforms, we will also develop a portable software infrastructure that facilitates the reliable use of GPUs in advanced automotive applications.

## Significance

This research will help General Motors specifically, and the U.S. automotive industry more broadly, in moving forward in using GPU technology to host advanced sensing capabilities in automotive systems.

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## Research Sponsor

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