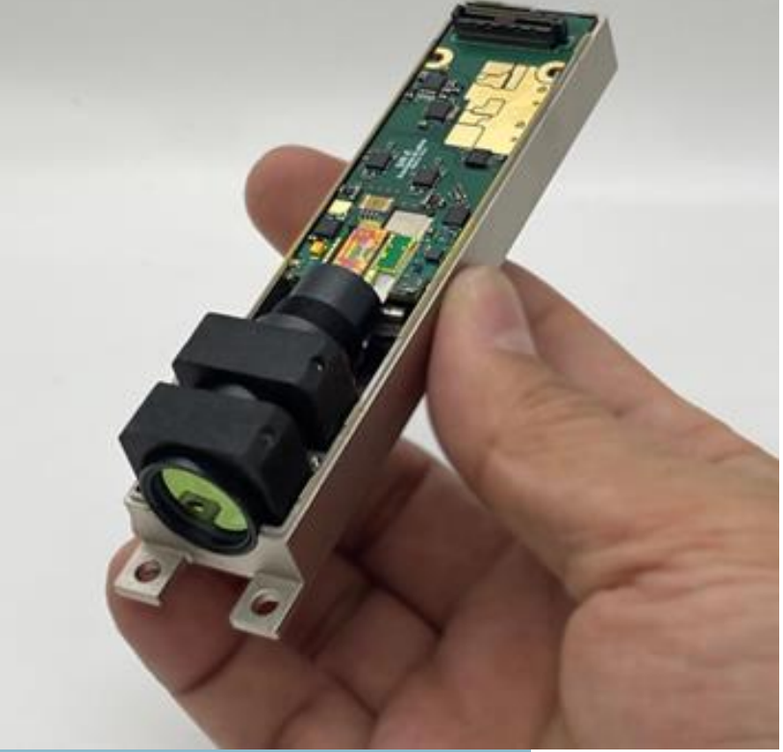


SiLC Technologies Eyeonic™ Vision Sensor Redefines LiDAR

Unique Sensor Uses AMD Adaptive SoC to Quickly Measure Distance, Range, and Speed of Moving Objects

PARTNER

SiLC

INDUSTRY

Industrial / Automotive

CHALLENGES

SiLC wanted to build an Eyeonic vision sensor with front-end circuits to drive lasers, detect analog photonic signals, and convert them to digital. Alternative discrete component solutions were very expensive, bulky, and not reliable.

SOLUTION

The AMD Zynq UltraScale+ RFSoC provides the ADCs needed for 4x Eyeonic sensors. The sample rate of these ADCs can easily handle performance-driven applications, from sub-mm precision at a few meters to several kilometers.

RESULTS

AMD RFSoCs eliminate the need for external data converters, enabling a flexible solution with reduced power and footprint over a multi-component solution, including the elimination of the power-hungry FPGA-to-analog interfaces.

AMD TECHNOLOGY AT A GLANCE

AMD Zynq UltraScale+ RFSoC

SiLC Technologies' mission is to empower machines with human-like visual perception to augment and enrich human life. The company was founded in June 2018, by engineers who pioneered commercialization of silicon photonics over 25 years ago, and it aims to redefine the imaging industry with high-performance, compute-efficient, optical image processing at the edge.

SiLC has developed a unique photonics integration platform enabled by a low-cost, scalable semiconductor manufacturing process. The platform consists of a vision sensor and a vision system. The company's target markets include mobility, industrial, robotics, infrastructure, entertainment, consumer, road safety, drone detection, and more.

The SiLC Eyeonic™ vision sensor includes all optical and electrical components in one device and is based on FMCW LiDAR technology. It can determine ranges by targeting an object or a surface with a laser and measuring the time for the reflected light to return to the receiver. It can also directly measure the speed of an object.

Some of the key features of this vision sensor are that it works in any lighting condition, is interference and hack immune, is eye safe due to its wavelength of operation (1,550 nm), and its long range and high resolution enable fast and reliable identification of objects and analysis of shape and form. In addition, the polarization and wavelength information processed by the sensor facilitates material identification and surface analysis, and the precise velocity estimates enable rapid threat detection and analysis of motion for object classification. The FMCW vision systems can deploy up to 4x vision sensors, and its flexible architecture allows for independent location of scanner heads from a central vision system. At the heart of the vision system is the adaptive AMD Zynq™ UltraScale+™ RFSoC.

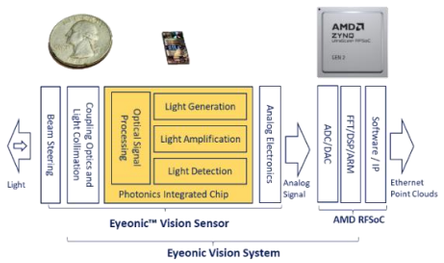
CHALLENGE

The Eyeonic vision sensor—which integrates the optical functions of an FMCW LiDAR, including laser, amplifier, waveguides, detectors (Ge based), and more—also needs front-end circuits to drive lasers, detect analog photonic signals and convert them to digital signals to be processed with proprietary software. For the latter, they need several A/D and D/A converters, DSP processors, and others electronic components to process the optical and electrical signals, which is addressed with an adaptive SoC from AMD.

The Eyeonic vision sensor is similar to a data center transceiver; it is basically a Tx/Rx LiDAR transceiver and contains all the critical functions to enable an FMCW LiDAR transceiver. The alternative of assembling an FMCW solution with discrete components is very expensive and, if connected with fiber, it is bulky and not reliable.

SOLUTION

The diagram below shows the integrated solution. The programmable device used in this design is a part of the AMD Zynq UltraScale+ RFSoC family . It provides the number of ADCs (8x 5 GSPS) that SiLC needs for 4x Eyeonic sensors. The sample rate of these ADCs can easily handle performance-driven applications, whether it is to achieve sub-mm precision at a few meters distance or to extend the maximum range of the LiDAR to several kilometers.



Both application spaces have been widely demonstrated by SiLC. Furthermore, the processing backbone of the Zynq UltraScale+ RFSoC allows for implementation of advanced LiDAR processing algorithms running in real time on this 40 GSPS aggregate data rate coming from the 8 ADC channels. The flexibility of the RFSoC fabric allows for frequent algorithm updates and has played a pivotal role in SiLC's innovation roadmap over the past few years.

Some of the alternative ways that Silc considered to address the challenge was to add individual ADC semiconductor solutions, which would provide a fixed and non-adaptable semiconductor solution, in addition to very high power consumption, due to JESD interfaces. Conversely, AMD products are known for their flexibility and capability to adjust to constantly changing conditions/environments, so SiLC considered this feature in their product design due to constantly evolving algorithms being used and the ability of AMD RFSoCs to adapt to those changes in the field.

RESULT

SiLC's chosen solution, the Zynq UltraScale+ RFSoC from AMD, is a monolithic integration of direct RF-sampling data converters onto an adaptive SoC, which eliminates the need for external data converters, enabling a flexible solution with reduced power and footprint over a multi-component solution—including the elimination of the power-hungry FPGA-to-analog interfaces like JESD204. The integration of ADCs and DACs into the adaptive SoC and the processing power to handle FMCW were the main reasons that SiLC chose the Zynq UltraScale+ RFSoC. This approach also enables a highly flexible solution, moving much of the RF signal processing into the digital domain. In fact, the Zynq UltraScale+ RFSoC is scalable across the client's portfolio depending on the number of channels they need and the required frequency of operation.

In its next-generation product, SiLC may move to a more powerful family of adaptive SoCs, like the AMD Versal™ portfolio, which would allow functions to be consolidated onto a single device, reducing a system's overall form factor while helping to decrease energy consumption. The Versal adaptive SoCs have both AI Engines and DSP Engines, the latter supporting a breadth of workloads common in edge applications, including AI inference, image processing, and motion control.

"SiLC's plan to use AMD FPGA-based adaptive computing goes beyond the RFSoC family," said the company's senior director of product engineering, Behnam Behroozpour. "We are looking forward to AMD's next-generation Versal adaptive SoCs, based on the AMD XDNA architecture. These devices are expected to provide around five times more processing power in the same footprint by sheer power of geometric scaling. In addition to scaling in device size, the architectural innovations in the Versal portfolio, complemented by the AI Engines, are designed to enable more efficient implementation of the algorithms that are in the core of SiLC's FMCW LiDAR processing chain. The heightened processing capabilities in the Versal devices are accompanied by a substantial boost in aggregate sample rate of the data converters in the Versal AI RF Series. These transformative enhancements in Versal devices, synergically paired with SiLC's state-of-the-art photonic integrated chips, have the potential to unlock an unprecedented level of performance for future generations of the SiLC Eyeonic™ vision system."

In addition to the superior AMD solution, Behroozpour added that the company has also enjoyed a "really strong support and network" from AMD and Avnet (an AMD distribution partner), plus a very strong engineering team, that facilitated the implementation of custom IP and architectures in the SiLC product.

WANT TO LEARN MORE?

About AMD Zynq UltraScale+ RFSoC

About SiLC Technologies

About SiLC
SiLC Technologies is a silicon photonics innovator delivering coherent vision and chip-scale FMCW LiDAR solutions that help machines see like humans. The company leverages deep expertise to advance market deployment of coherent 4D imaging solutions across a wide range of industries – including mobility, industrial machine vision, AI robotics, augmented reality, and consumer applications. For more information: https://www.silc.com.

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