論 文 の 内 容 の 要 旨

論文題目　A Study of Image Sensors
with In-Pixel Selective-Signal Detection
（画素回路内信号選択機能を有する
イメージセンサに関する研究）

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Active sensing using image sensors are widely used in various applications, including 3- D range finding for mobile devices and automobiles. Traditional image sensors for active sensing have mainly four challenges: temporal resolution, spatial resolution, dynamic range, and power consumption. Moreover, in recent applications with active sensing, the instrument security has been big issue with the security of measurement system. Many studies and re- searches have shown remote attacks on active-sensing-based system such as LiDAR and ToF, and proposed software and hardware countermeasures that improve resilience against these attacks. These studies and researches mainly have aimed at system-level and software-level solutions. However, these options require additional space, demand additional processing capacities, and increase cost, which is problematic in lowly cost-driven applications. The approach and solutions of sensor-level are required like these applications.

This thesis presents a new approach for an image sensor that can detect the selective signal while suppressing the background light for such application like 3-D range-finding with modulated and coded light. This thesis focuses on the implementation of selective-signal detection imaging systems. Two type of image sensors are proposed and implemented to improve the reliability of measurement.

First, we propose An Image Sensor with In-pixel Selective-Charge- Subtraction Circuits for Selective Light Detection. For the detection of selective-signal light

from incident lights, in-pixel demodulation transistors are employed. And Adaptive Charge Unit (ACU) in pixel circuit is introduced to prevent the saturation problem by the background light. Demodulation transistors and a charge injection mode suppression circuit using FD level sensing circuit for background light realize high sensitivity. The image sensor has been designed, fabricated, and successfully measured.

Second, we propose an image sensor with compensation of background light using current mirror. To achieve selective-light detection, in-pixel demodulation transistors are employed. Current mirror circuit in pixel circuit in introduced to duplicate the photo current by the back- ground light, and to prevent the saturation problem during integration time. Demodulation transistors and a charge injection mode suppression circuit using current mirror circuit for background light realize high sensitivity. The image sensor has been designed, fabricated, and will be measured.

These results in this thesis, such as two type of image sensors and active optical sensing with modulated light and coded light, could be used for the instrumental security, and contribute to the active optical sensing performance and reliability improvements.