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Beyond the temporal resolution limit of silicon image sensors

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The temporal resolution limit of silicon image sensors is 11.1 ps as we proved. We defined the super temporal resolution (STR) as the resolution less than this limit, since most image sensors are silicon-based [1]. To achieve the STR, mixing effects along the travel route of signal electrons in a pixel, elongating the temporal resolution, are separately analyzed and the countermeasures are proposed. A branching gate image sensor is proposed with a resistive gate for the center guide gate [2]. It is verified by simulations that the proposed sensor structure can achieve theoretically noiseless imaging at the temporal resolution of 100 ps with an existing 120-nm process. A finer process with a germanium photodiode, in addition, will achieve the STR (<11.1 ps) in the near future [3].
[1] T. G. Etoh., "Toward Super Temporal Resolution by Suppression of Mixing Effects of Electrons", https://imagesensors.org/Past%20Workshops/2021%20Workshop/2021%20Papers/R34.pdf, submitted to IEEE T-ED.
[2] N. Ngo et al., "A Pixel Design of a Branching Ultra-Highspeed Image Sensor", Sensors, 21(7) (2021) (IF:3.6). DOI: 10.3390/s21072506
[3] N. Ngo et al., "Toward the Super Temporal Resolution Image Sensor with a Germanium Photodiode for Visible Light", Sensors, 20(23) (2020) (IF: 3.6). DOI: 10.3390/s20236895

Primary authors: SHIMURA, Takayoshi (Osaka University); ETOH, T. Goji (Osaka University); WATANABE, Heiji (Osaka University)

Presenter: ETOH, T. Goji (Osaka University)

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