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Analog Integrated Circuit for Edge Detection with Massively Parallel Processing Based on Vertebrate Outer Retina

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An analog circuit for edge detection was proposed based on vertebrate outer retinas. In order to realize a wide dynamic range of light intensity, a simple logarithmic compression photocircuit based on a photoreceptor in the retina was utilized at the first stage of a unit circuit. A function for digitizing an output current was inserted at the last stage to solve the problem of incorrect operation caused by noise and device mismatches. The chip which contains 40×40 unit circuits in a two-dimensional array was fabricated with 0.35 μm complementary metal oxide semiconductor (CMOS) process. The measured results of the chip and the results with the simulation program with integrated circuit emphasis (SPICE) showed that edge positions can be detected correctly with a dynamic range of 6 decades. It was clarified that the fabricated chip can detect edge positions even if regions with extremely different brightness levels were contained in an input image. In addition, an edge pattern of a moving object was detected at 100 frames/s and the capability for massively parallel processing was confirmed.

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