Group 3-5 A Model for Plane Detection in MST

Hiroaki OKAMOTO

Fujitsu Limited

A neural network model for detecting a planar surface spatially from the optical flow in area MST of the visual cortex

We report a neural network model that detects three plane parameters (i.e., three-dimensional orientation, time-to-contact, and the shortest distance) by integrating an optical flow in area MST. We constructed the modeled network with 0.16×10^8 cells and 4.6×10^8 connections in a computer, and precisely simulated the responses of the model.
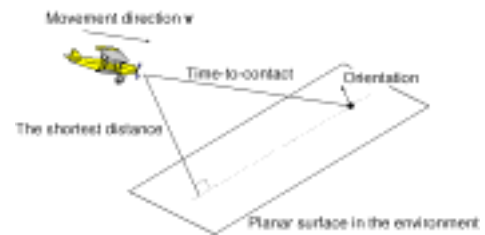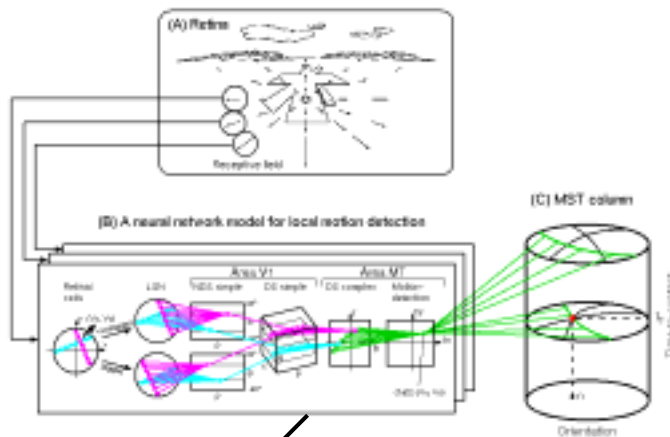

Fig.1 Three types of plane parameters detected by the model: three-dimensional orientation of the plane, time-to-contact to the plane, and the shortest distance to the plane.

Model descriptions

Fig.2 A neural network model linking retinal and MST cells is schematically depicted. MST cells are arranged in a column and the connections between area MT and MST were formulated by the cross-ratio transform and polar transform. A local motion detection model detects local velocity within each receptive field. Integrating the local velocities, an MST cell corresponding to the plane's parameters will be maximally activated.

Java applet downloadable

Fig.3 Local velocity detection algorithm (Hough and inverse Hough transform, and spatio-temporal correlation) in area MT was interactively illustrated using a Java applet.
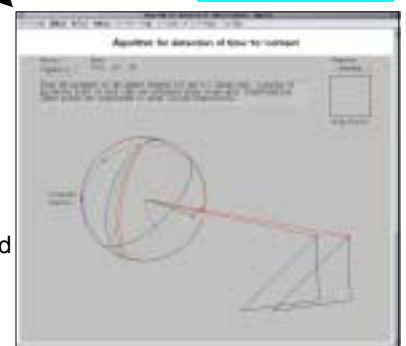
Fig.4 Plane parameter detection algorithm (cross-ratio transform and polar transform) in area MST was interactively illustrated.

Simulation results

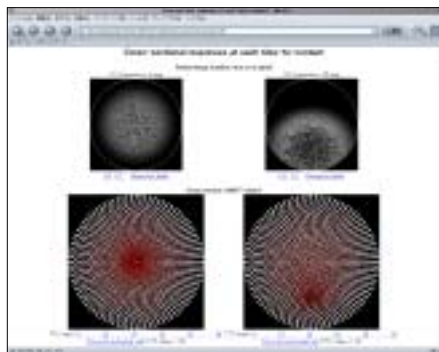**Simulated data downloadable**

Fig.5 *Top*: Retinal images of an approaching plane with random-dots on it. *Bottom*: Cross-sectional responses of MST column at each time-to-contact. Circles represent MST cells. The cell of maximal response correctly indicated the orientation of the plane.
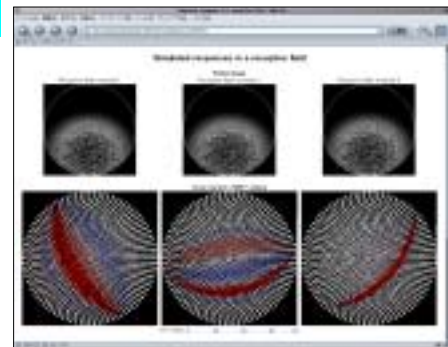

Fig.6 *Top*: Retinal images with a receptive field. *Bottom*: Cross-sectional responses of MST columns in each receptive field. Integrating these responses all over the visual field, the response on the lower right in Fig. 5 was obtained.