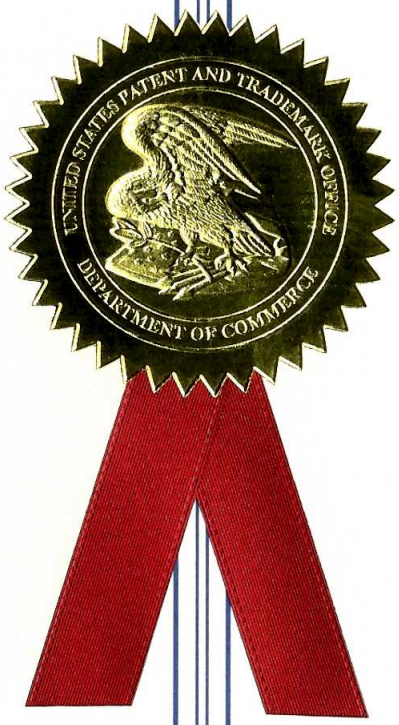
The United States of America



The Director of the United States Patent and Trademark Office

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, or importing into the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

David J. Kappos

Director of the United States Patent and Trademark Office

US008077945B2

(12) **United States Patent**
Kawato et al.

(10) **Patent No.: US 8,077,945 B2**
(45) **Date of Patent: Dec. 13, 2011**

(54) **METHOD OF ANALYZING CELL OR THE LIKE HAVING LINEAR SHAPE, METHOD OF ANALYZING NERVE CELL AND APPARATUS AND PROGRAM FOR PERFORMING THESE METHODS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 790 days.

(21) Appl. No.: **12/086,496**

(22) PCT Filed: **Nov. 13, 2006**

(86) PCT No.: **PCT/JP2006/322537**

§ 371 (c)(1),
(2), (4) Date: **Aug. 14, 2008**

(87) PCT Pub. No.: **WO2007/068856**

PCT Pub. Date: **Jun. 21, 2007**

(65) **Prior Publication Data**

US 2009/0070089 A1 Mar. 12, 2009

(51) **Int. Cl.**
G06K 9/00 (2006.01)

(52) **U.S. Cl.** **382/128**; 382/133

(58) **Field of Classification Search** ..... None
See application file for complete search history.

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(57) **ABSTRACT**

It is intended to propose a technique whereby a nerve cell is morphologically analyzed automatically based on a three-dimensional image of the nerve cell. First, a dendritic projection is traced by using the scale space method. In this step, irregularities are reduced by using the σ-convolution smoothing method and thus the center line of the dendritic projection is identified. Next, a negative curvature is searched for by the Hess tensor method. The part corresponding to the negative curvature in all coordinate axes is judged as the area occupied by "heads". The center of this area (heads) is referred to as the spine position. Approximation is made on the assumption that the spine head has an ellipsoidal shape. Thus, the minor diameter, medium diameter and major diameter of the ellipsoid are calculated. From the spine position, a perpendicular line is dropped toward the dendritic projection closest thereto and this perpendicular line is considered as the column part. By combining the dendritic projection with the spine head and column thus obtained, the final morphological shape of the nerve cell is obtained.

25 Claims, 16 Drawing Sheets