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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte ZHIMIN HUO and XU LIU

Appeal 2011-011041
Application 11/414,759
Technology Center 3700

Before MELANIE L. McCOLLUM, JEFFREY N. FREDMAN, and JACQUELINE WRIGHT BONILLA, *Administrative Patent Judges*.

McCOLLUM, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 involving claims to a method for determining a candidate lesion region in a digital ultrasound medical image. The Examiner has rejected the claims as obvious. We have jurisdiction under 35 U.S.C. § 6(b). We reverse.

STATEMENT OF THE CASE

Claims 1, 2, and 4-13 are pending and on appeal (App. Br. 1). We will focus on claim 1, which reads as follows:

1. A method for determining a candidate lesion region in a digital ultrasound medical image of anatomical tissue, the method comprising using a processor or computer to perform automatically steps of:

accessing the digital ultrasound medical image of anatomical tissue;

applying an anisotropic diffusion filter to the ultrasound image to generate a filtered ultrasound image;

performing a normalized cut operation on the filtered ultrasound image to partition the filtered ultrasound image into a plurality of regions;

merging the plurality of regions into merged regions based on predetermined threshold values; and

selecting, from the merged regions, at least one region as a candidate lesion region.

Claims 1, 2, and 4-13 stand rejected under 35 U.S.C. § 103(a) as obvious over Kupinski[1] in view of Madabhushi[2] and Shi[3] (Ans. 3-4).

The Examiner relies on Kupinski for disclosing "methods and an associated system for detecting a lesion in an ultrasound image of anatomical tissue" (*id.* at 4). The Examiner finds that Kupinski teaches "a computer readable medium to perform the steps of the method automatically" (*id.*).

With regards to a normalized cut, the Examiner notes that Appellants' Specification "disclose[s] normalized cut to partition images into plurality of regions . . . and segmenting spatially contiguous pixels" (*id.*). The Examiner finds that Kupinski teaches "partitioning of spatially contiguous pixels of

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[1] Kupinski et al., US 6,138,045, Oct. 24, 2000.

[2] Anant Madabhushi and Dimitris N. Metaxas, *Combining Low-, High-Level and Empirical Domain Knowledge for Automated Segmentation of Ultrasonic Breast Lesions*, 22 IEEE TRANSACTIONS ON MEDICAL IMAGING 155-169 (2003).

[3] Jianbo Shi and Jitendra Malik, *Normalized Cuts and Image Segmentation*, 22 IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE 888-905 (2000).

similar intensity . . . in which a lesion will not exhibit vast variation in pixel values, which is interpreted to mean that the partitioned regions have substantially similar intensity patterns" (*id.*). The Examiner also finds that Kupinski teaches "segmenting the image into a plurality of regions according to intensity patterns; selecting candidate lesion regions as those having a lower intensity value than a threshold value; and classifying the candidate lesion regions" (*id.*). In addition, the Examiner finds that Kupinski discloses that "the task of a lesion segmentation algorithm is to partition a set (I) into two sets . . . and further mention[s] pixel values of all images are normalized" (*id.*).

The Examiner relies on Madabhushi for disclosing an "anisotropic diffusion filter to remove speckle (or noise) . . . ; a method to merge neighboring regions into larger regions and then appl[y] an averaging filter to each region" (*id.* at 5). The Examiner relies on Shi for teaching "normalized cut" (*id.*). The Examiner concludes:

> [O]ne with ordinary skill in the art at the time the invention was made would have been motivated to combine Kupinski et al with Madabhushi et al by using an anisotropic diffusion filter on the image and Shi et al by using normalized cut operation; for the purpose of enhancing the signal to noise ratio; thus improving visualization.

(*Id.*)

FINDINGS OF FACT

1. Kupinski discloses:

> A method for the automated segmentation of an abnormality in a medical image, including acquiring first image data representative of the medical image; locating a suspicious site at which the abnormality may exist; establishing a seed point

> within the suspicious site; and preprocessing the suspicious site with a constraint function to produce second image data in which pixel values distant of the seed point are suppressed. . . . The method further includes applying plural thresholds to the second image data to partition the second image data at each threshold; identifying corresponding first image data for the partitioned second image data obtained at each respective threshold; determining a respective index for each of the partitioned first image data; and determining a preferred partitioning, for example that partitioning leading to a maximum index value, based on the indices determined at each threshold, and segmenting the lesion based on the partitioning established by the threshold resulting in the maximum index.

(Kupinski, Abstract.)

2. Kupinski also discloses that, "while the above discussion relates largely to detection of lesions in mammograms, . . . segmentation of the abnormality can be preformed [sic, performed] also on 3-dimensional datasets. . . . Examples of such abnormalities for segmentation include masses in 3-dimensional medical images (magnetic resonance imaging or ultrasound imaging) of the breast." (*Id.* at col. 12, ll. 39-57.)

3. Madabhushi discloses:

> Speckle is a particular kind of noise which affects ultrasound images, and can significantly reduce their quality and diagnostic usefulness. . . . Guo discussed an adjacency graph method to merge neighboring regions into larger regions and then applying an averaging filter to each region. Other filters such as anisotropic diffusion filter . . . have also been applied to sonographic images to remove speckle.

(Madabhushi 158.)

4. Shi discloses:

> We propose a novel approach for solving the perceptual grouping problem in vision. Rather than focusing on local

> features and their consistencies in the image data, our approach aims at extracting the global impression of an image. We treat image segmentation as a graph partitioning problem and propose a novel global criterion, the *normalized cut*, for segmenting the graph. The *normalized cut* criterion measures both the total dissimilarity between the different groups as well the total similarity within the groups.

(Shi, Abstract.)

ANALYSIS

First, we agree with Appellants that the Examiner has not set forth a prima facie case that Kupinski teaches, either expressly or inherently, a normalized cut operation (App. Br. 6). The evidence of record indicates that a normalized cut operation is a specific way to partition an image (Finding of Fact (FF) 4). Thus, although Kupinski partitions an image (FF 1), we conclude that the Examiner has not shown that Kupinski uses a normalized cut operation.

In addition, we agree with Appellants that the Examiner has not adequately explained why it would have been obvious to incorporate Shi's normalized cut operation into Kupinski's method (App. Br. 8). As noted above, the Examiner concludes that it would have been obvious "to combine Kupinski et al with Madabhushi et al by using an anisotropic diffusion filter on the image and Shi et al by using normalized cut operation; for the purpose of enhancing the signal to noise ratio; thus improving visualization" (Ans. 5). However, the Examiner does not explain why a normalized cut operation would be expected to enhance the signal to noise ratio. In fact, it appears that this reasoning applies only to the combination of Madabhushi with Kupinski.

We also agree with Appellants that the Examiner has not set forth a prima facie case that it would have been obvious "to combine the claimed performing, merging and selecting steps" (App. Br. 9). The Examiner notes that Madabhushi teaches "a method to merge neighboring regions into larger regions" (Ans. 5; *see also* FF 3). However, as noted by the Examiner, Madabhushi "then applie[s] an averaging filter to each region" (*id.*). The Examiner has not adequately explained why it would have been obvious to merge a plurality of regions formed by a normalized cut operation.

CONCLUSION

The Examiner has not set forth a prima facie case that Kupinski, Madabhushi, and Shi suggest the method of claim 1. We therefore reverse the obviousness rejection of claim 1 and of claims 2 and 4-13, which depend from or otherwise incorporate the features of claim 1.

REVERSED

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