Automatic Pathology Software for Diagnosis of Non-Alcoholic Fatty Liver Disease
OTT ID #1236

TECHNOLOGY

The invention is a supervised machine learning approach for automatically classifying "white-regions" of liver biopsies into 1 of 7 categories, thus providing an important decision support system for pathologists. White-region classification can be applied in multiple analyses performed on liver biopsies, with assessment of steatosis (fat) grade (SG) perhaps being the most direct. With the development of high resolution scanners for liver (and other) biopsies, automated methods that process digitized images can now be used in the clinic. This invention provides a fully automated way to accurately and quickly estimate SG without the inherent variability of human assessment. Currently the method can accurately classify more than 90% of the white regions, which include steatosis (fat) and the important anatomical landmarks such as bile ducts, hepatic arteries and portal veins.

Although SG is a key factor in the diagnosis and staging of common liver diseases, pathologist's manual assessment of SG is semiquantitative, discontinuous, and variable. Variation in the assessment of steatosis, necroinflammation, and fibrosis can lead to errors in diagnosis and staging of Non-Alcoholic Fatter Liver Disease (NAFLD), the most common liver disease in the United States. The goal of this work is to provide computational methods for quantification of these key histological features with less variable scores to improve patient outcome.

FEATURES/BENEFITS

- **Automatic** – Supervised machine learning to automatically learn rules for classification of white regions

- **Multiple Applications** – Can be used in quantification of steatosis grade, rapid assessment of candidate donor livers in the transplant setting, and biopsy index database search

- **Faster** – Quicker classification of biopsies

- **More accurate** – Minimizes variability observed in diagnosed made by human pathologists
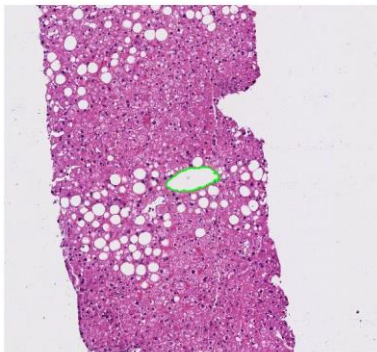

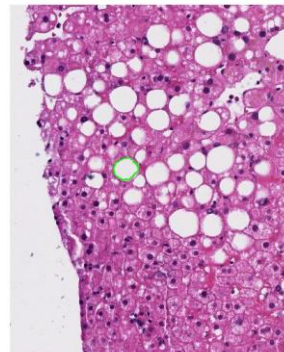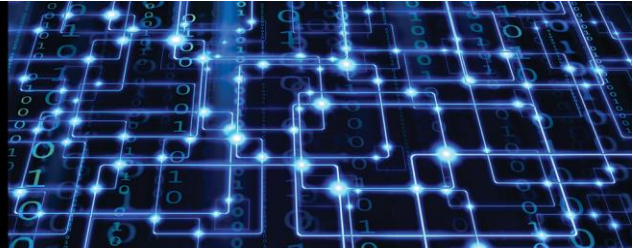**Figure 1. A central vein (shown outlined) identified by a multilayer perceptron neural network**

Figure 2. Macro-vesicular steatosis (shown outlined) identified by a multilayer perceptron neural network

INTELLECTUAL PROPERTY

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PUBLICATIONS

Gawrieh, S., Knoedler, D.M., Saeian, K. Wallace, J.R., and Komorowski, R.A. Effects of interventions on intra- and interobserver agreement on interpretation of nonalcoholic fatty liver disease history. Annals of Diagnostic Pathology. 2011. 15: 19-24.

MARKETS

NAFLD is the most common liver disease in children and adults in the U.S., affecting about 13% of children and 30% of adults, or about 25 million Americans. Accurate distinction of mild from severe forms of the disease is crucial because the mild form rarely progresses while the severe form can progress to cirrhosis in about 25-30% of the cases.

The global market for liver disease treatments was $400 million in 2009 and expected to increase to more than $700 million by 2014. Direct costs associated with liver biopsy in 2002 were $1,500-2,000. Computer aided detection and diagnosis (CAD), originally used in image analysis and the development of algorithms for image recognition, has evolved to offer full workflow management packages for a range of healthcare conditions. Use of CAD can provide a more economically viable proposition for busy, cost-focused healthcare providers. CAD allows physicians to deal with enormous data sets more efficiently, making their job easier and in turn making physicians more accurate.

www.bccresearch.com; American Liver Foundation;
http://www.businesswire.com/news/home/20110824006105/en/Computer-Aided-Detection-Diagnosis-Market-Exhibit-Steady

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Dr. Joseph Bockhorst is an Assistant Professor in the Department of Computer Science and Electrical Engineering at the University of Wisconsin-Milwaukee. He received his Ph.D. in Computer Sciences from the University of Wisconsin-Madison and conducted Post-Doctoral work in the machine learning and applied statistics group with Microsoft Research. Dr. Bockhorst's research focuses on machine learning and probabilistic approaches for uncovering patterns in sequential or temporal data. Dr. Samer Gawrieh is an Associate Professor in the Department of Gastroenterology and Hepatology, and the Medical Directory of Liver Transplantation at the Medical College of Wisconsin. His area of expertise includes Non-Alcoholic Fatty Liver Disease, liver transplantation, and liver disease.

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