Brain Segmentation through Deep Learning | by Li Zhao

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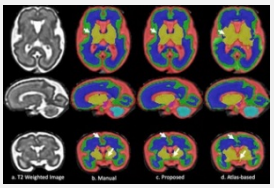
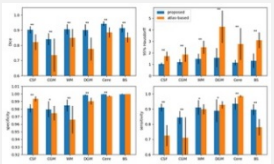
Director's Message

The closing of one year and beginning of another is always a time for reflection. Our team has much to be grateful for and much to celebrate over a year of impressive accomplishments. This year we celebrated the success of several grants awarded to our program from the NIH Heal Initiative, NIH Human Placenta Project, and the Bush Lawson Foundation. Equally exciting has been the continued growth of our training program which has become competitive and highly sought after. Our training environment is recognized to be exemplary as we proudly train the next generation of medical and scientific leaders. We congratulate our award winners at the 2019 International Symposium for the Fetal Brain, the NARSAD Young Investigator Award, the CTSI-KL2 training award and the CTSI-CN pilot award. Our research has been featured on the Children's National Innovation District website and widely through main news outlets. Finally, we proudly celebrate an inclusive landscape that welcomes the diversity of our faculty, staff, graduate students, fellows, residents, medical students, and interns. Everyone has a seat at the table. Working together, we continue to set a new bar and aspire to be transformational in our care of our smallest and most vulnerable patients. All your hard work and dedication throughout the year is much appreciated. I look forward to a busy and productive 2020. I know you share my excitement for what's to come. Happy Holidays!

Li Zhao, PhD
Research Faculty





What is the study about?

Accurate assessment of fetal brain anatomy in the second and third trimester of gestation is important in identifying early impairments in fetal growth. Magnetic resonance imaging (MRI) has been used to investigate volumetric and morphological developments of the fetus with advancing gestational age (GA). The segmentation process however present significant challenges to acquiring fetal images, some of which are due to irregular fetal movements that result in serious motion artifacts, high variations between each tissue and low image contrast. The focus of this research study is to develop deep learning techniques that enable the automatic segmentation of the fetal regions. This method has been used to identify the subregions of the fetal brain, the fetal body, and the cerebrospinal fluid regions of patients with hydrocephalus.

What are some advantages that emanate from this study?

The proposed method has three advantages:

- Manual segmentation is more accurate than the current state of the art Draw-EM segmentation method.
- Its performance is robust across gestational ages.
- The proposed method is highly efficient, allowing 30 seconds to completion of each segmentation.

How is your research relevant to the work that we do in the lab?

This method is now regularly implemented in our current fetal imaging processing pipeline to process fetal scans and will provide real-time and quantitative information to support clinical diagnosis by reducing the clinical data processing time.

Research Presentations

16th Biennial Meeting of the Diabetes in Pregnancy Study Group of North America (DPSG-NA). Oct 2019

Andescavage N. Placental microstructure in diabetic pregnancies assessed by diffusion-weighted magnetic resonance imaging (DW-MRI).

Pradhan S. Brain biochemical profiles in fetuses of pregnant women with diabetes.

4th International Symposium on the Fetal Brain (ISFB) Nov 2019

Lu YC. Impact of maternal stress, depression, and anxiety on fetal brain cortical development.

Dadkhoo D. Volumetric analysis of preterm newborn brain with normal, mild injury, and moderate injury.

Zhao L. Inter-rater variance in fetal brain segmentation.

Zun Z. Measurement of blood oxygenation of the fetal brain using MR quantitative susceptibility mapping.

Pradhan S. Brain biochemical profiles in fetuses of pregnant women with diabetes.

Wu Y. Altered global and regional subplate growth in fetuses with Congenital Heart Disease.

Czopek S. Differences in cortical plate and subplate development between fetuses with CHD and fetuses from low risk pregnancies.

Largent A. Automatic Assessment of Fetal MRI Quality: a deep learning approach.

Congratulations

Kushal Kapse on your 2019 ISFB Abstract Award

Prenatal brain growth impairments predict neurodevelopmental outcome in infants with congenital heart disease.

Research Publications

Wu Y, Kapse K, Jacobs M, Andescavage N, Donofrio M, Krishnan A, Vezina G, Wessel D, du Plessis A, Limperopoulos C. Elevated maternal psychological distress impairs in utero brain development in fetuses with congenital heart disease. *JAMA Pediatrics*. In Press.

You W, Andescavage NN, Kapse K, Donofrio MT, Jacobs M, Limperopoulos C. Hemodynamic responses of the placenta and brain to maternal hyperoxia in fetuses with Congenital Heart Disease by using Blood Oxygen-Level Dependent MRI. *Radiology*. 2019 Nov 5:190751.

Welcome New Team Members!

Kristina Espinosa
Psychologist

Todd Richmann
Project Associate

Featured Press

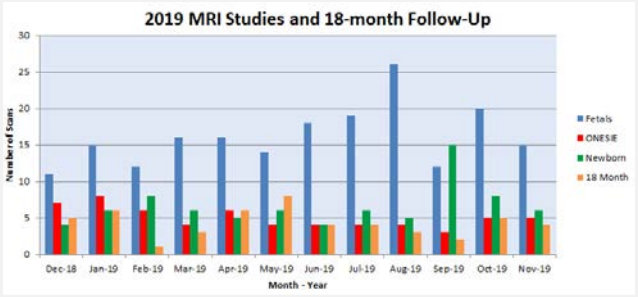
Novel approach to detect growth restriction

Opioids' imprint on the developing fetal brain

Children's National Hospital using sophisticated MRI to track impact of opioids on infant brains

2019 Study Updates

Kudos to our Study Coordination Team!



We performed 333 fetal-neonatal MRI studies and over 50 neurodevelopmental follow up studies in 2019!

Upcoming Events

January 7th, 2020 – In-Utero MRI, Oxford UK

March 13th, 2020 – Society for Reproductive Investigation (SRI) Mini-Symposium