Automated Stroke Analysis: An AI-driven Solution for DSA Parameter Identification

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01. Background

Strokes are a significant health concern, with one in four individuals potentially experiencing a stroke in their lifetime. They are the **second leading cause** of **mortality** and the **third largest cause** of **disability** in adults worldwide. Ischemic strokes, accounting for about 71% of all strokes, occur when blood flow is reduced due to arterial blockage.

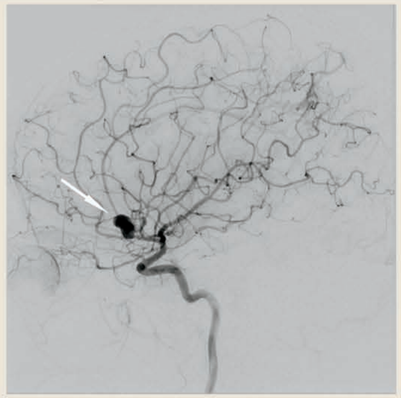
Digital subtraction angiograms (DSA) are widely used for diagnosing and treating ischemic stroke patients, providing valuable insights into the affected blood vessels in the brain. DSA imaging is crucial for understanding the pathogenesis of stroke and informing the development of new treatments and therapies for ischemic stroke patients.

02. Project Motivation

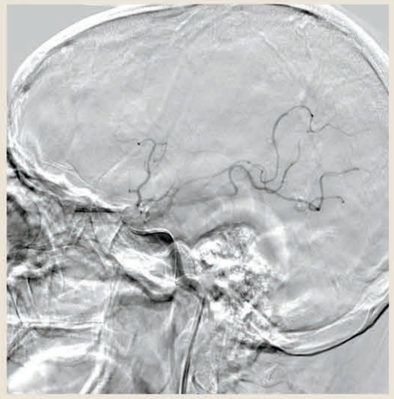
The current process of extracting standard parameters from DSA images for clinical trials and research faces several challenges:

- **Time-consuming:** Trained radiologists must evaluate each image in a dataset containing thousands of images for each participant, making the process lengthy and inefficient.
- **Cost-prohibitive:** Employing trained radiologists for this task can be expensive, posing a financial burden on research and clinical trial budgets.
- **Reliability concerns:** There is a risk of low inter-reader reliability, as different radiologists might have varying levels of expertise and experience in identifying the parameters of interest.

These issues are particularly severe in the context of stroke research, where timely and accurate analysis is crucial for the development and evaluation of new therapies. **The motivation for this project lies in addressing these challenges** and improving the accuracy, efficiency, and reliability of extracting standard parameters such as stroke severity, hemisphere, recanalization, and outcome from DSA images.



Blockage identified in a DSA image



Sample image in .dcm file

03. Proposed Solution

The proposed solution is to develop a machine-learning algorithm capable of automating the extraction of the desired parameters from large DSA image datasets. This approach will eliminate concerns related to time, cost, and reliability, providing a more efficient, cost-effective, and reliable method for extracting parameters from DSA images.

The machine learning algorithm will:

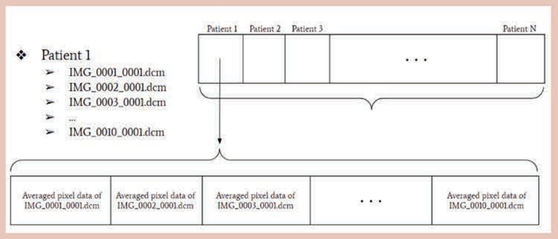
- **Be trained on a set of images with accurate parameters, allowing it to accurately and efficiently extract information from the images.**
- **Open and manipulate images within DICOM files.**
- **Interpret each DSA image individually, extracting the corresponding parameters.**
- **Detect occlusion and determine if recanalization has occurred.**
- **Identify the location (or hemisphere) of the occlusion.**

By automating the extraction of these parameters, the machine learning algorithm will address the challenges posed by the current manual process, resulting in a more efficient, cost-effective, and reliable solution for analyzing DSA images in clinical trials and research, ultimately accelerating the development of new treatments and therapies for ischemic stroke patients.

04. Methodology & Design

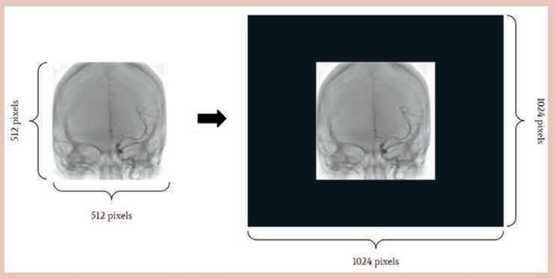
Data Organization:

- **Raw Data:** Raw data is stored in DICOM files, which include a header (metadata) and a series of image data.
- **Processed Data:** Data is divided into two arrays:
  - **Array 1** contains averaged pixel data from all DICOM files for each patient in a single orientation, which can be reconfigured as needed.
  - **Array 2** consists of 0s and 1s representing recanalization status, corresponding to the order in Array 1 (0 for no recanalization, 1 for recanalization).



Processed Data - Array 1

Standardization: All images are normalized to a consistent 1024 x 1024 dimension, achieved by padding zeros along the image edges to match the largest dimension found in the dataset.



Standardized image to size: 1024x1024

Training the model:

- The selected model is **ResNet50** using transfer learning in Python with **TensorFlow**
-

05. Results

Summarize your study and let the viewers know two to three key findings. You can also add a description of each that can give them an idea of what comes next. This section can also include any implications of the study, and if there are any actions or recommendations for future study.