'ISCHEMIC STROKE DETECTION IN NON-ENHANCED COMPUTED TOMOGRAPHY EXAMINATIONS'

Allan F. F. Alves [1], Ana J. M. Sampaio [1], Nadine H. P. B. Maues [1], Marcela de Oliveira [1], Ana L. M. Pavan [1], Carlos C. M. de Freitas [3], Nitamar Abdala [4], D. R. Pina [2]

[1]Institute of Biosciences of Botucatu /Department of Physics and Biophysics, Unesp, Botucatu, Brazil
[2]Faculty of Medicine of Botucatu/Department of Tropical Diseases and Imaging Diagnosis, Botucatu, Brazil
[3]Faculty of Medicine of Botucatu/Department of Neurology, Psychology and Psychiatry, Botucatu, Brazil
[4]Medical School of São Paulo/Institute for Research and Education in Diagnostic and Therapeutic Medicine, São Paulo, Brazil

Paper Number: PP154 Email: allan@ibb.unesp.br

Allan F. F. Alves, Ana J. M. Sampaio, Nadine H. P. B. Maues, Marcela de Oliveira,
Ana L. M. Pavan, Carlos C. M. de Freitas, Nitamar Abdala, D. R. Pina
allan@ibb.unesp.br

1st EUROPEAN CONGRESS OF MEDICAL PHYSICS
EFOMP
September 1-4, 2016
Eugenides Foundation
Athens-Greece

INTRODUCTION:

- Stroke is a worldwide concern, only in Brazil it accounts for 10% of all registered deaths.
- Early diagnosis is essential to avoid irreversible cerebral damage.
- Non-enhanced computed tomography (NECT) is the main diagnostic techniques used to diagnose stroke.

Allan F. F. Alves, Ana J. M. Sampaio, Nadine H. P. B. Maues, Marcela de Oliveira,
Ana L. M. Pavan, Carlos C. M. de Freitas, Nitamar Abdala, D. R. Pina
allan@ibb.unesp.br

1st EUROPEAN CONGRESS OF MEDICAL PHYSICS
EFOMP
September 1-4, 2016
Eugenides Foundation
Athens-Greece

INTRODUCTION:

Stroke Diagnosed with CT

- Distinguish between ischemic and hemorrhagic stroke.
- Ischemic stroke with hemorrhagic transformation >> the wrong choice of treatment can lead to patient death;

Hyperdense area of hemorrhage

Chawla et al. (2009)

Allan F. F. Alves, Ana J. M. Sampaio, Nadine H. P. B. Maues, Marcela de Oliveira,
Ana L. M. Pavan, Carlos C. M. de Freitas, Nitamar Abdala, D. R. Pina
allan@ibb.unesp.br

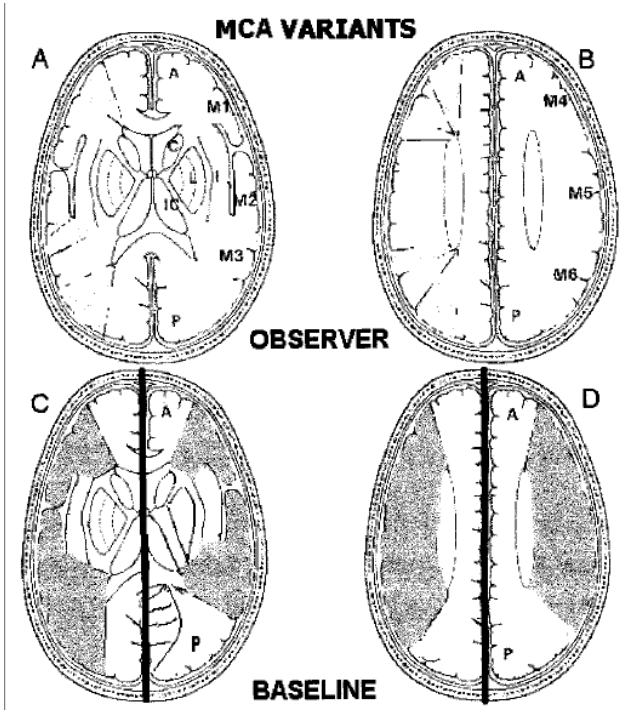
1st EUROPEAN CONGRESS OF MEDICAL PHYSICS
EFOMP
September 1-4, 2016
Eugenides Foundation
Athens-Greece

INTRODUCTION:

ASPECTS - *Alberta Stroke program early CT score*

- Standard ischemic stroke diagnosis with a reproducible scoring system. The score divides the middle cerebral artery (MCA) territory into 10 regions of interest.

This analysis is thus a subjective estimative of the affected area by ischemic stroke.



Allan F. F. Alves, Ana J. M. Sampaio, Nadine H. P. B. Maues, Marcela de Oliveira,
Ana L. M. Pavan, Carlos C. M. de Freitas, Nitamar Abdala, D. R. Pina
allan@ibb.unesp.br

1st EUROPEAN CONGRESS OF MEDICAL PHYSICS
EFOMP
September 1-4, 2016
Eugenides Foundation
Athens-Greece

PURPOSE:

- The aim of this work was to implement an image segmentation and enhancement algorithm to detect ischemic stroke lesions in NECT scans.

Allan F. F. Alves, Ana J. M. Sampaio, Nadine H. P. B. Maues, Marcela de Oliveira,
Ana L. M. Pavan, Carlos C. M. de Freitas, Nitamar Abdala, D. R. Pina
allan@ibb.unesp.br
1st EUROPEAN CONGRESS OF MEDICAL PHYSICS
EFOMP
September 1-4, 2016
Eugenides Foundation
Athens-Greece

METHODS:

- Construction of a database with retrospective examination of patients diagnosed with stroke;

- **Inclusion criteria**
- Patient diagnosed with stroke by specialist (neuroradiologist);
- CT scans acquired with at least 16 slices scanner;

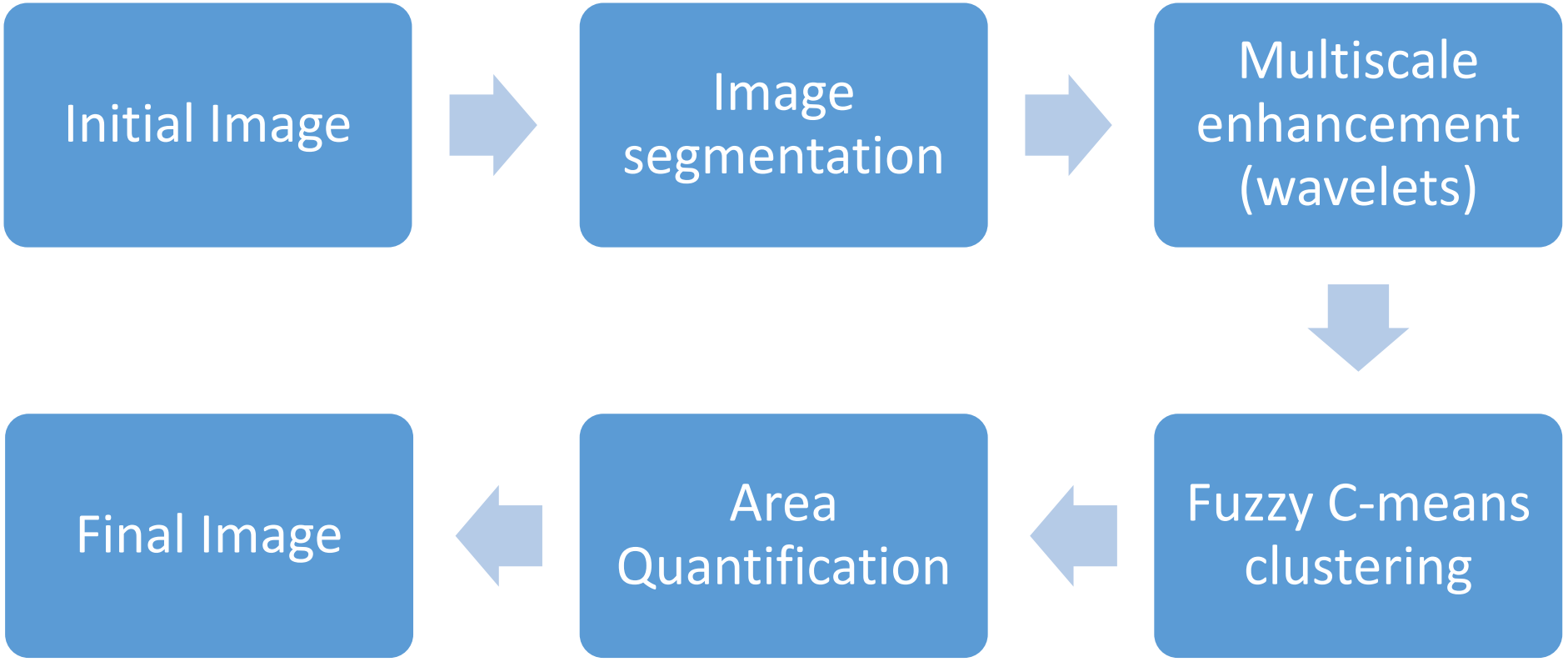
- **Exclusion criteria**
- History of intracranial hemorrhage;
- Malformations, tumors and aneurysms.

Allan F. F. Alves, Ana J. M. Sampaio, Nadine H. P. B. Maues, Marcela de Oliveira,
Ana L. M. Pavan, Carlos C. M. de Freitas, Nitamar Abdala, D. R. Pina
allan@ibb.unesp.br

1st EUROPEAN CONGRESS OF MEDICAL PHYSICS
EFOMP
September 1-4, 2016
Eugenides Foundation
Athens-Greece

METHODS:

Computational algorithm was developed in Matlab software



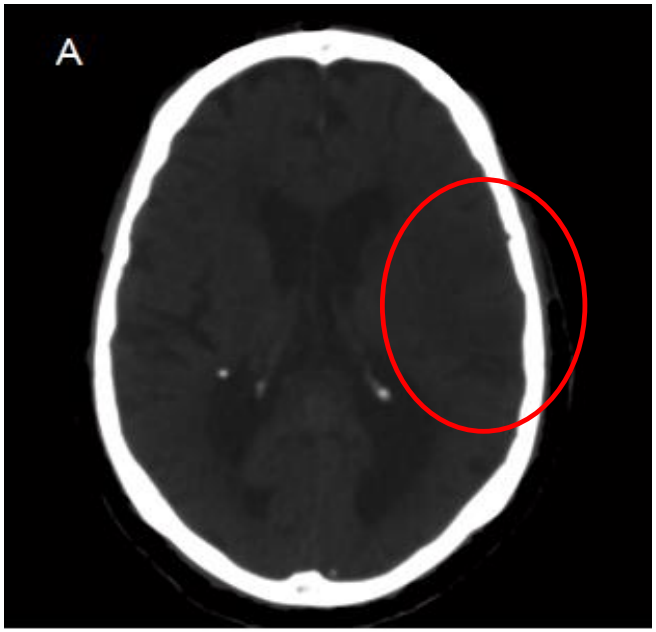
Allan F. F. Alves, Ana J. M. Sampaio, Nadine H. P. B. Maues, Marcela de Oliveira,
Ana L. M. Pavan, Carlos C. M. de Freitas, Nitamar Abdala, D. R. Pina
allan@ibb.unesp.br

1st EUROPEAN CONGRESS OF MEDICAL PHYSICS
EFOMP
September 1-4, 2016
Eugenides Foundation
Athens-Greece

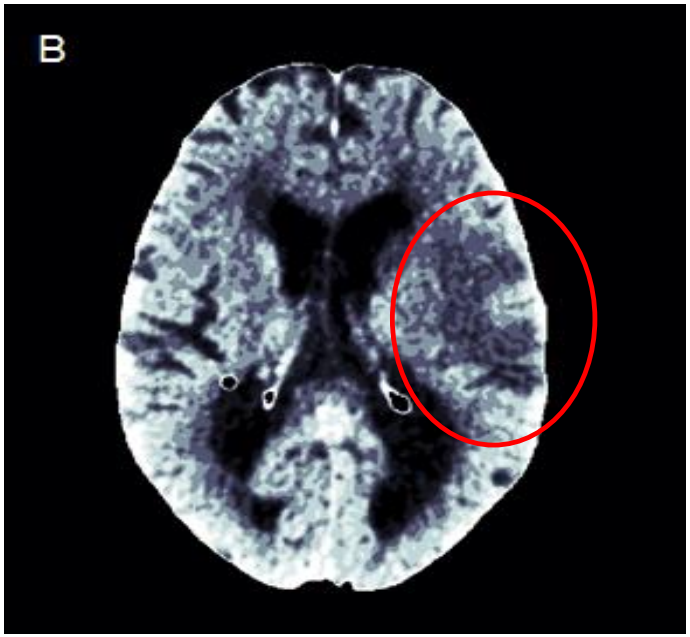
METHODS:

Multiresolution analysis via Wavelets: enhances morphological characteristics and frequencies presented in the image.

Fuzzy c-means clustering (FCM): identifies natural groups or cluster of pixels within each CT slice, which highlighted the areas affected by ischemic stroke.



A) Original image



B) Image after applying the algorithm.

Allan F. F. Alves, Ana J. M. Sampaio, Nadine H. P. B. Maues, Marcela de Oliveira,
Ana L. M. Pavan, Carlos C. M. de Freitas, Nitamar Abdala, D. R. Pina
allan@ibb.unesp.br

1st EUROPEAN CONGRESS OF MEDICAL PHYSICS
EFOMP
September 1-4, 2016
Eugenides Foundation
Athens-Greece

RESULTS:

- 15 patients were analyzed;

- Neuroradiologists found that the morphological filters actually improved visualization of ischemic areas;

- The comparison between the neuroradiology's subjective analysis and the computational algorithm showed a good agreement between detected areas affected by ischemic stroke.

Mean percentage difference = 16 %

Allan F. F. Alves, Ana J. M. Sampaio, Nadine H. P. B. Maues, Marcela de Oliveira,
Ana L. M. Pavan, Carlos C. M. de Freitas, Nitamar Abdala, D. R. Pina
allan@ibb.unesp.br

1st EUROPEAN CONGRESS OF MEDICAL PHYSICS
EFOMP
September 1-4, 2016
Eugenides Foundation
Athens-Greece

CONCLUSIONS:

Aid for the inexperienced or non-specialist radiologists

These results indicates the importance of a **computer aided diagnosis software** to assist neuroradiology decisions, especially in critical situations such as the choice of treatment for ischemic stroke.

- Greater efficiency in the diagnosis;
- Early diagnosis (within 3 hours of treatment window);