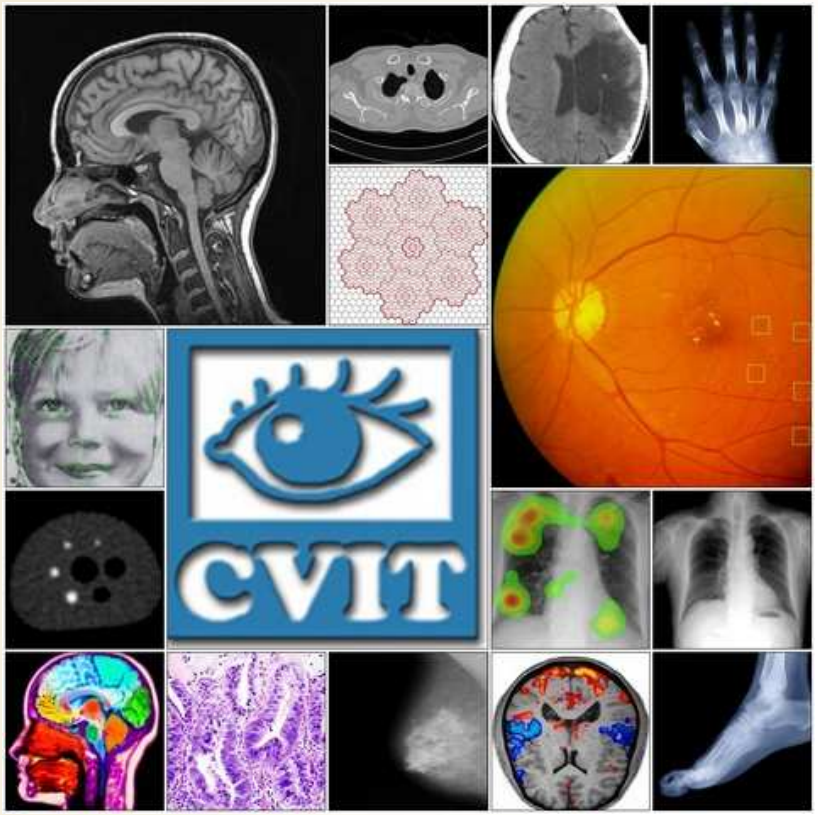
Medical Image Processing

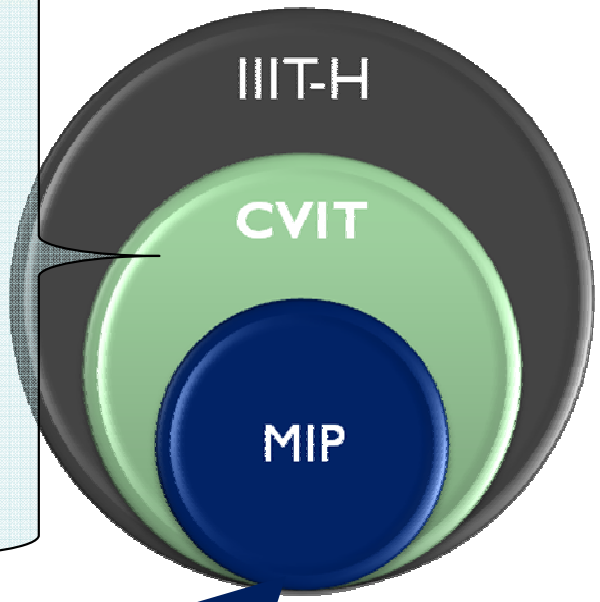


Jayanthi Sivaswamy

Centre for Visual Information Technology,

International Institute of Information Technology - Hyderabad

- Core research areas
  - Image Processing, Computer Vision and Graphics
  - Pattern Recognition & Machine Learning
- CVIT today has
  - 4 faculty members
  - Over 40 research and 20-25 UG honours students
- Largest vision research group in India



- Medical image processing
  - Early detection tools
  - Decision support systems
- Current focus areas
  - Retinal image analysis
  - Brain image analysis
- 2 PhD students, 9 MS students and 7 B.Tech students.

MIP team (current)

Prof. Jayanthi Sivaswamy

Gopal Joshi		Mayank Chawla	
Keerthi Ram		Vidhyadhari Gondle	
Saurabh Sharma		Kartheek N V	
Yogesh Babu		Neha Dixit	
Sandeep Kaushik		Sai Deepak	
Varun Jampani			

- PhD student
- M.S student

Current focus areas

Retina

LVPEI, Hyderabad
Dr Taraprasad Das
Dr Alka Rani
Dr Hemant Trehan

AECS, Madurai
Dr Krishnadas
Dr Kundan Karan
Dr Prashath

Stroke

CARE, Hyderabad
Dr L T Kishore
Dr Matin Siddique

Dementia

KIMS, Hyderabad
Dr Ravi Varma

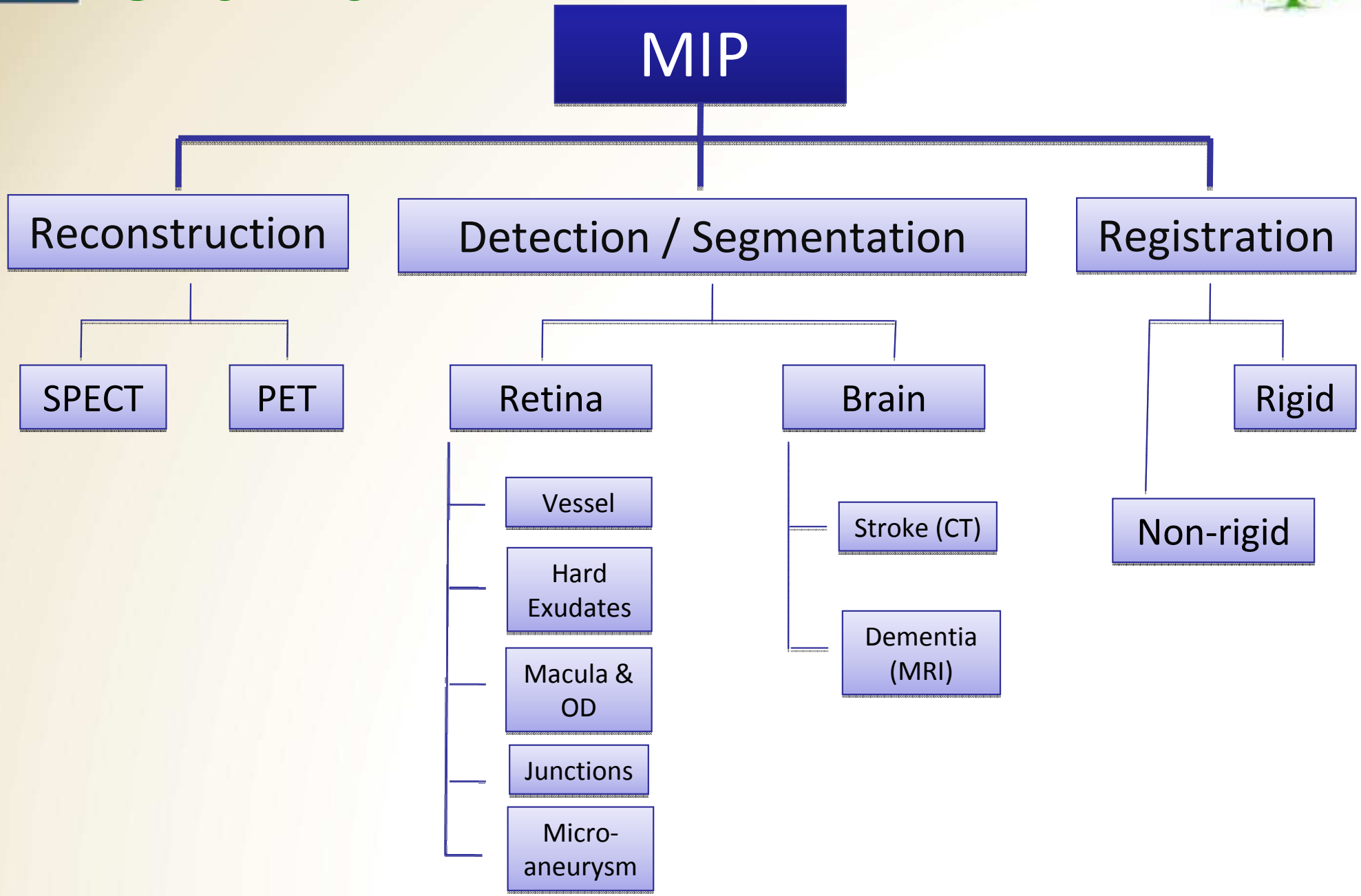
Research focus

Analysis of medical images

- Image Enhancement
- Quality assessment
- Segmentation of anatomical structures
- Multimodal information fusion

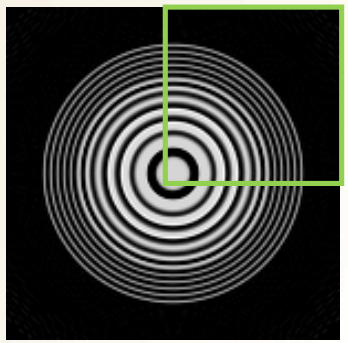
- Abnormality Detection
- Quantification of abnormality
- Computer Aided Diagnosis tools

Overview


MIP
Reconstruction
Detection / Segmentation
Registration
SPECT
PET
Retina
Brain
Rigid
Vessel
Stroke (CT)
Non-rigid
Hard Exudates
Dementia (MRI)
Macula & OD
Junctions
Micro-aneurysm

Reconstruction of tomographic images

Objective - Improve the resolution of tomographic images by combining rotated versions of low resolution images.

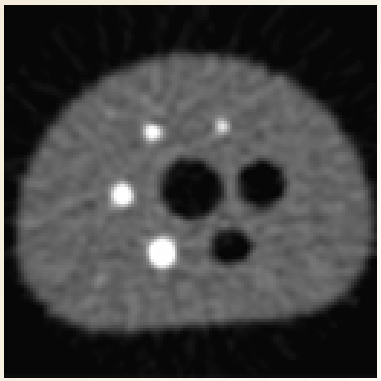


Original (analytical phantom)

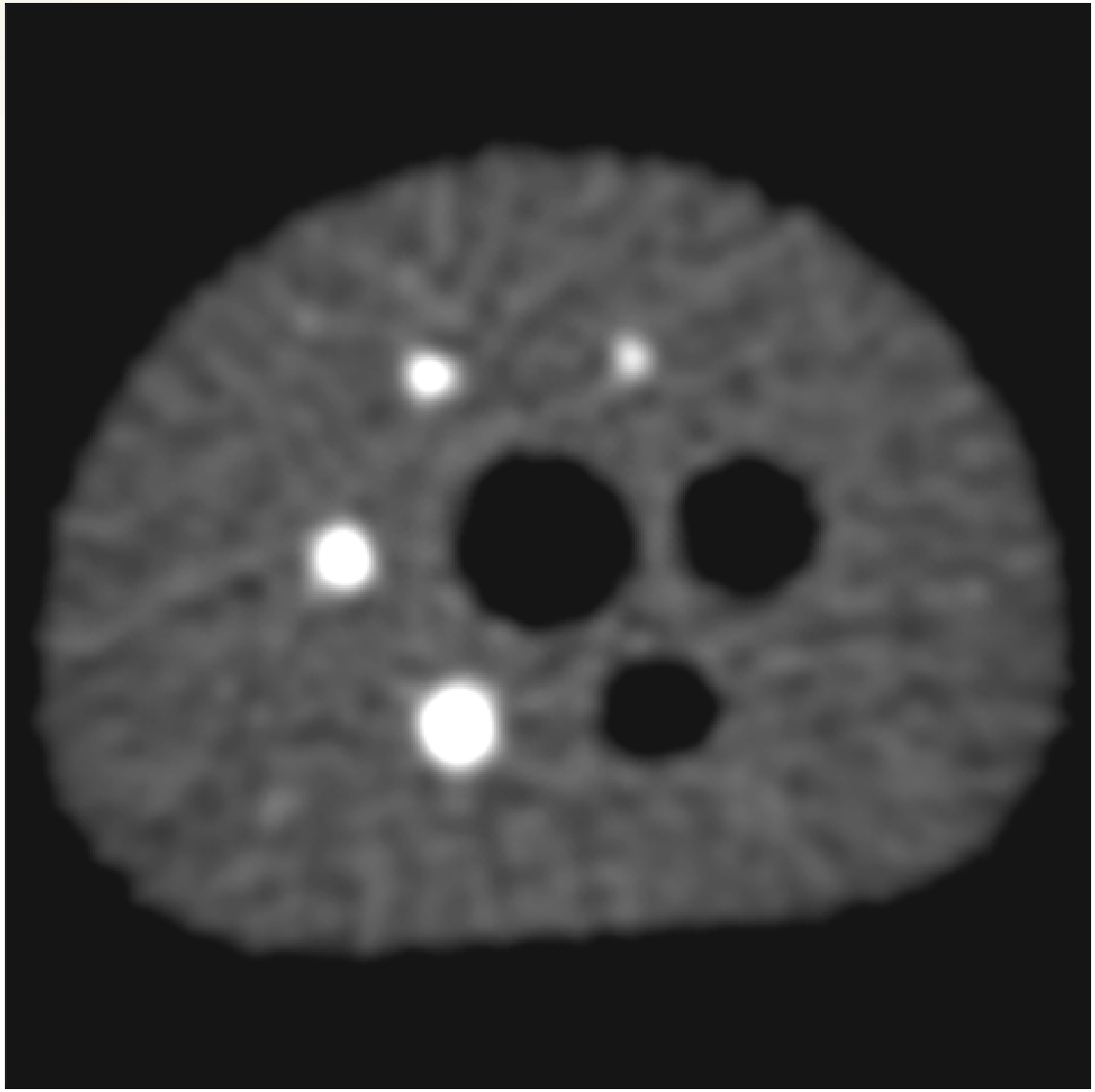
Upsampled by a factor of *four*

1. N. Dixit, *et al*, IEEE-NSS-Medical Imaging Conference,2009.
2. N. Dixit and J. Sivaswamy, NCC, 2009

Reconstruction of tomographic images



Original (NEMA phantom)

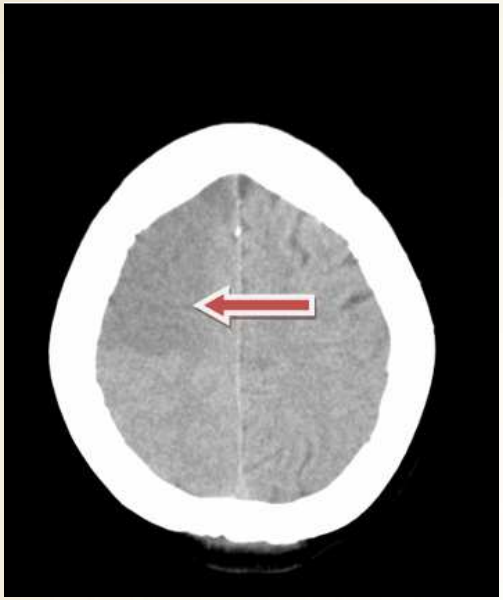


Upsampled by a factor of *four*

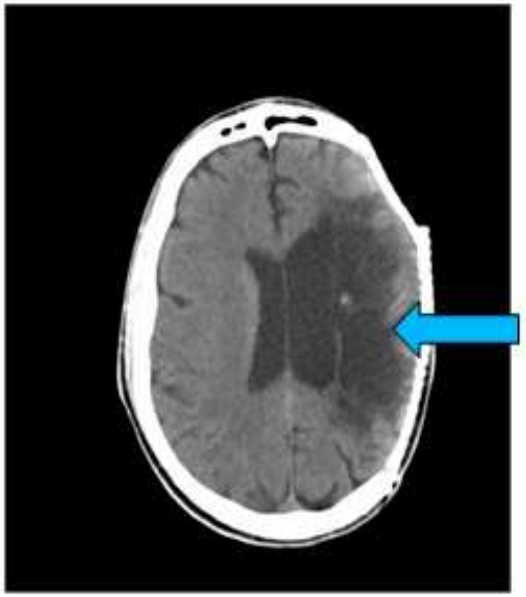
1. N. Dixit, *et al*, IEEE-NSS-Medical Imaging Conference,2009.
2. N. Dixit and J. Sivaswamy, NCC, 2009

Stroke

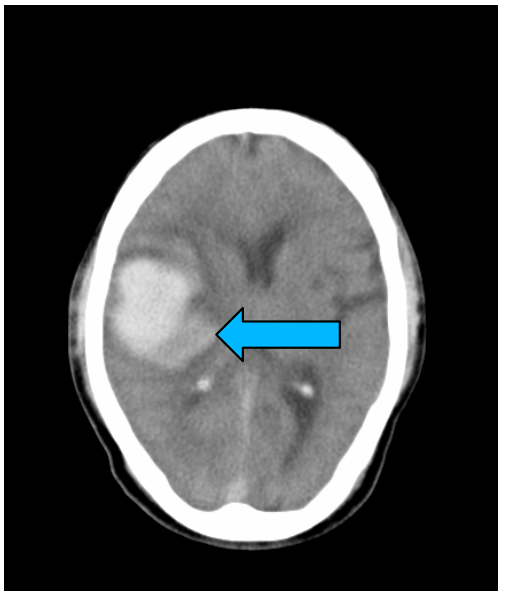
- Objective - To automatically detect and classify stroke (infarct), at the slice level, in *CT* volume data [1]



Acute Infarct



Chronic Infarct



Hemorrhagic stroke

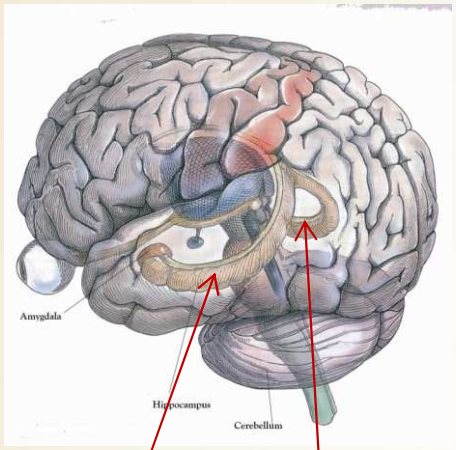
- Current focus - To automatically detect core and penumbra regions in *MRI* using multi-modal image fusion

M. Chawla, *et al*, IEEE EMBC 2009.

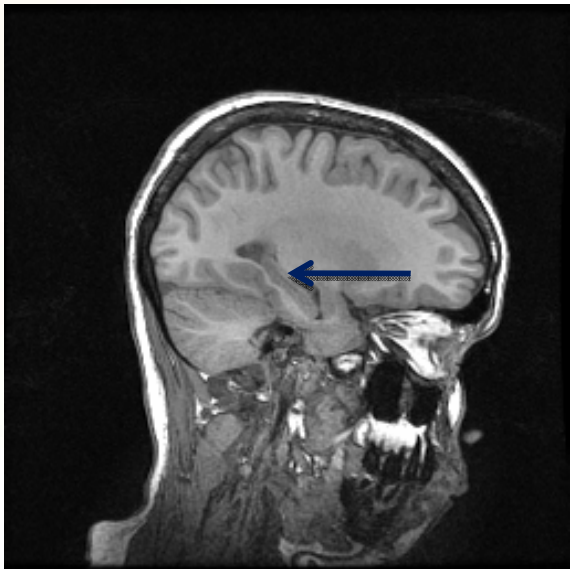
In association with CARE Hospital, Hyderabad

Dementia

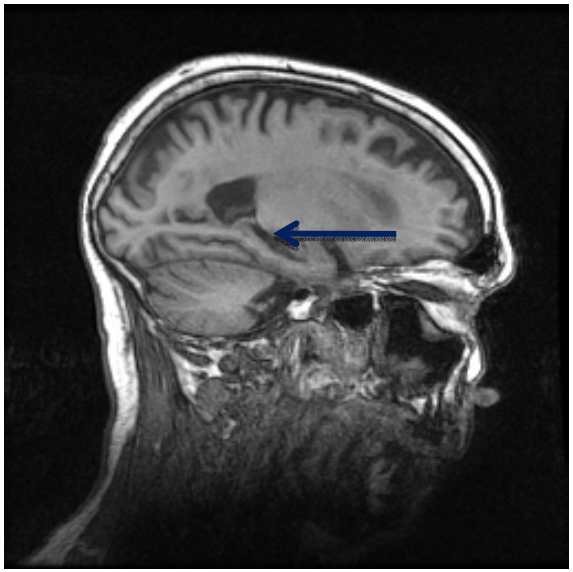
- Structural imaging of brain can be used as a marker to detect and track *dementia*.
  - Objective is to segment and perform volumetric analysis of hippocampus in MRI data.
  - Atrophy in hippocampal volume is used for early detection of dementia.



Hippocampi



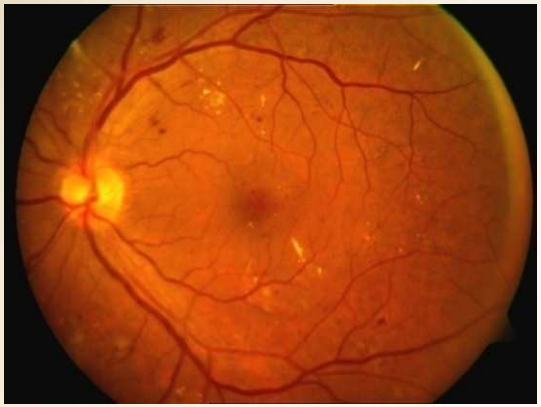
Normal

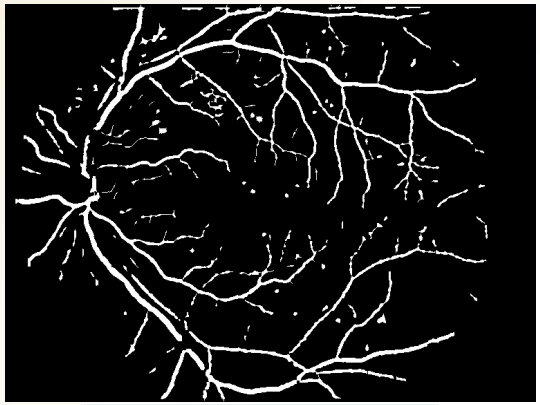


Abnormal

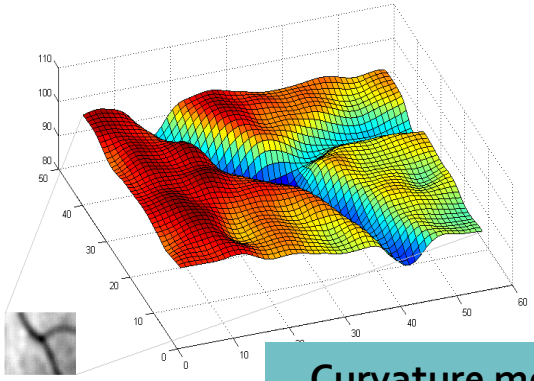
In association with Krishna Institute of Medical Sciences, Hyderabad

Retinal image analysis

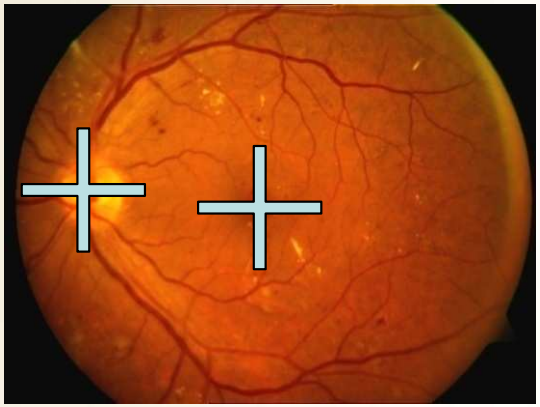




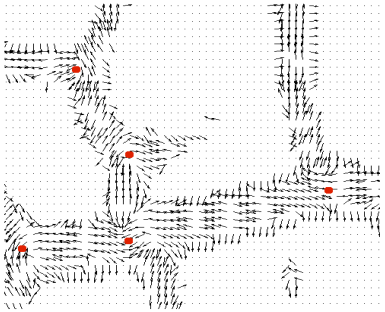
Vessel extraction

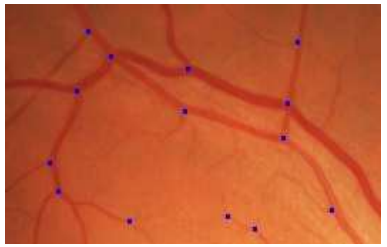


Curvature modeling

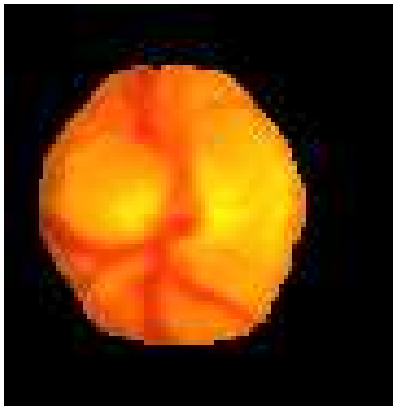


Optic Disk (OD) & Macula Detection



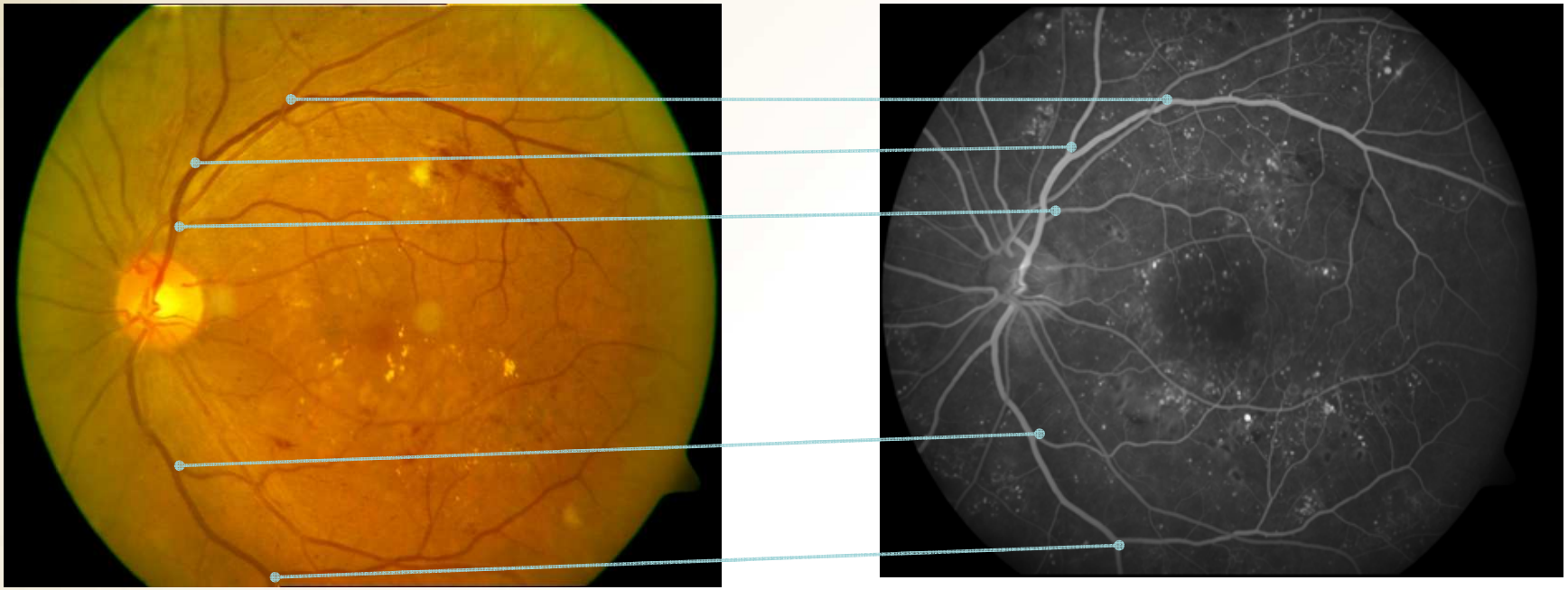


Junction Extraction



OD Segmentation

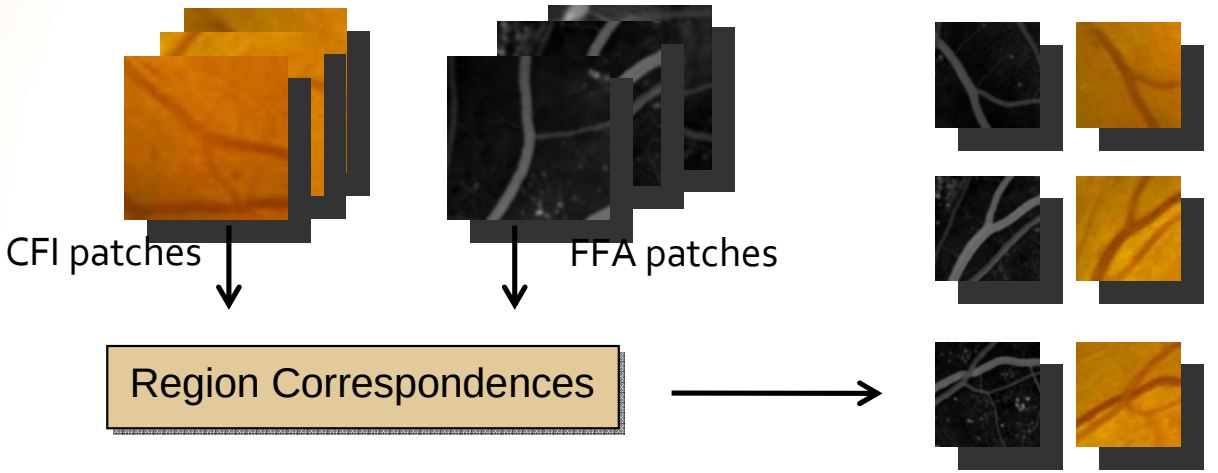
Cross modal registration



CFI Image

FFA Image

Partial Results



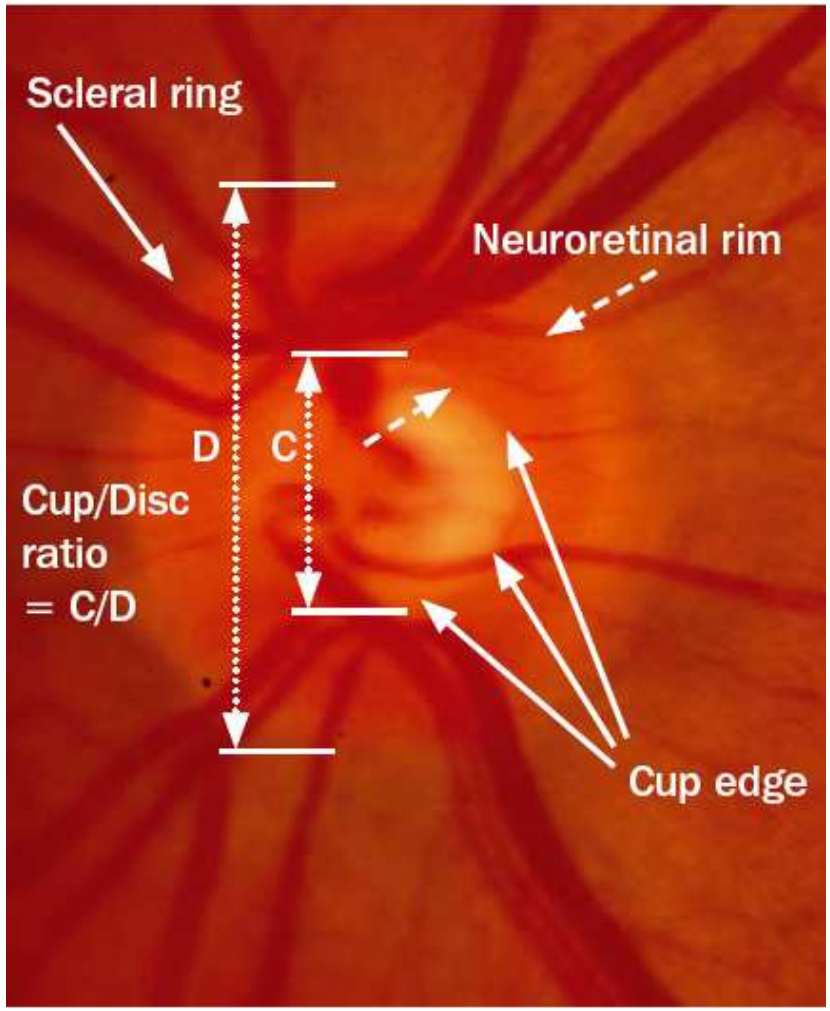
Glaucoma analysis

- Optic disc cupping

Category	No. of samples	Mean Error	Standard Deviation
Normal	40	0.030	0.277
Glaucoma	130	0.121	0.366
Total	170	0.100	0.348

Estimation of vertical cup-to-disk ratio error

- Retinal nerve fibre layer defect
- Neuro-retinal rim loss
- Optic Disk haemorrhage



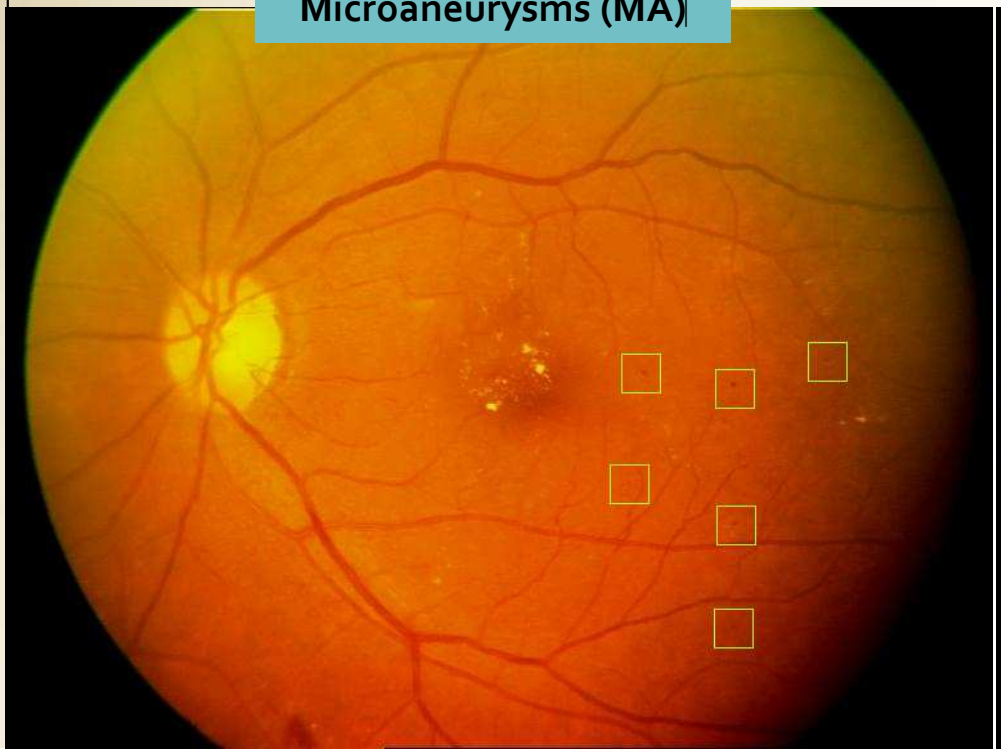
Zoomed view of Optic Disk Region

G.D. Joshi, et. al., ISBI 2010.

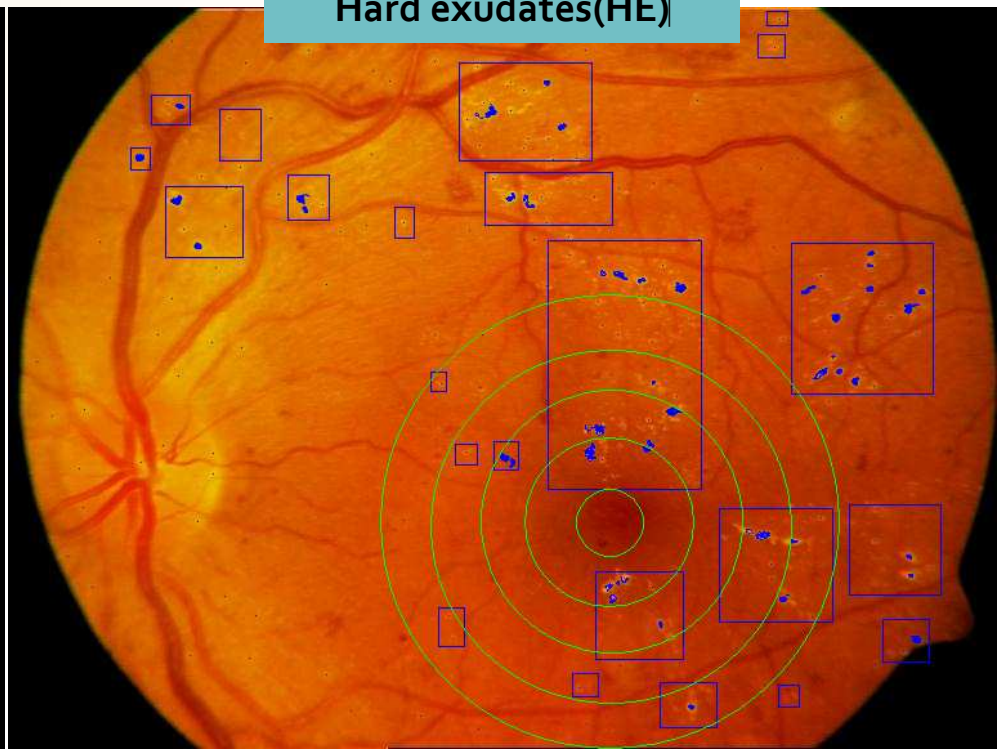
In association with Aravind Eye Care System (AECS), Madurai

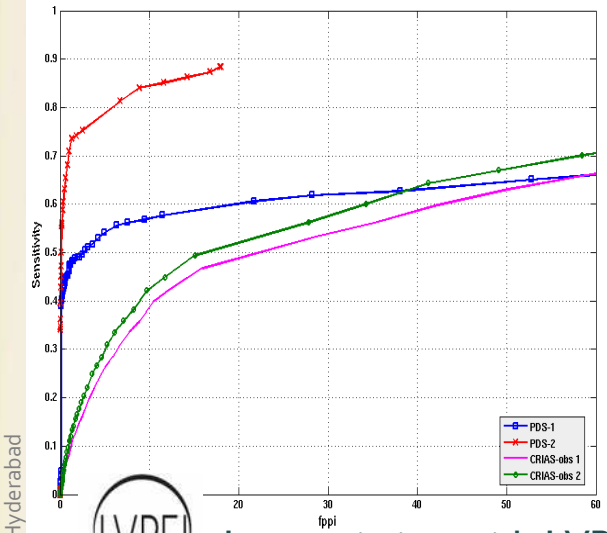
Detection of early DR

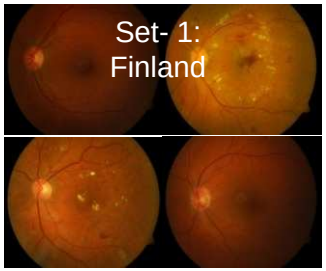
Microaneurysms (MA)

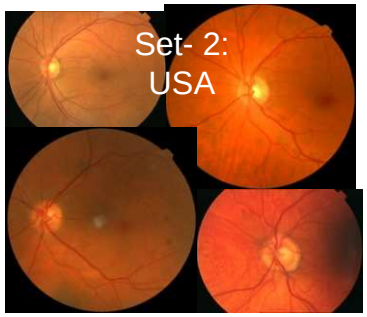


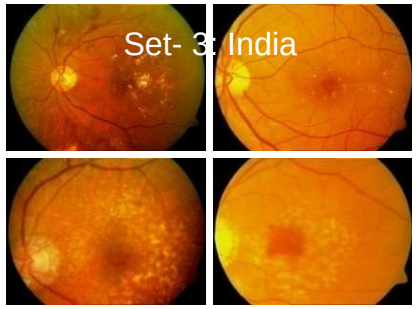
Hard exudates(HE)









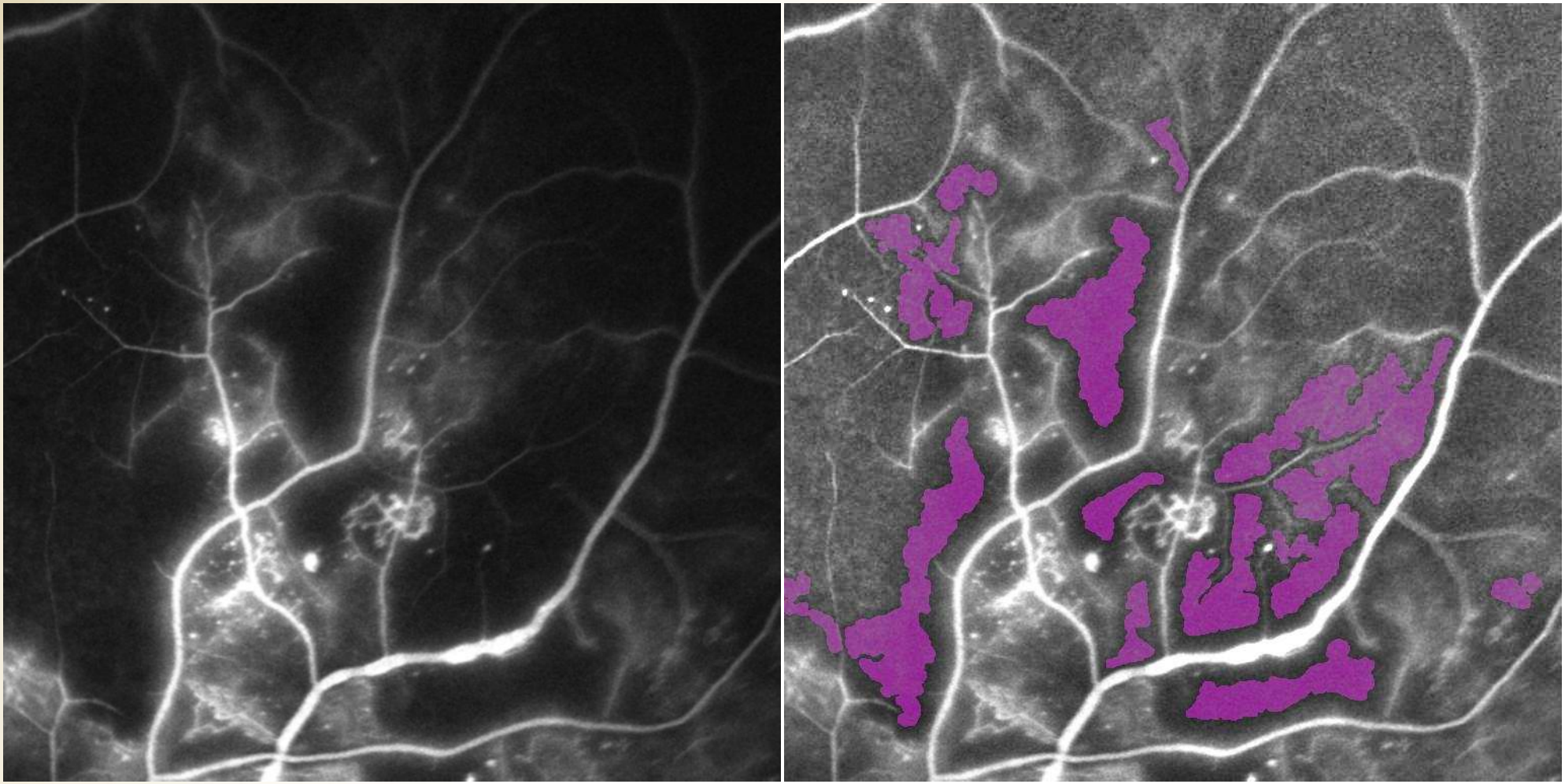


Fundus images taken under varying protocol

K. Ram and J. Sivaswamy, IEEE EMBC 2009

In association with LVPEI, Hyderabad

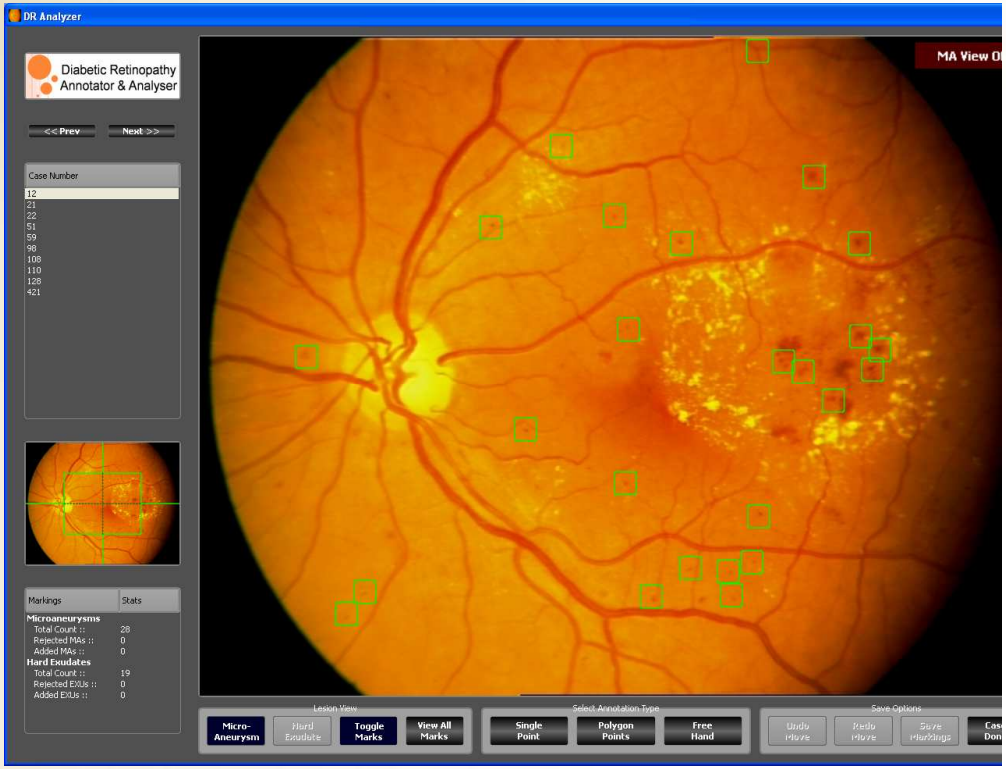
Detection of late DR



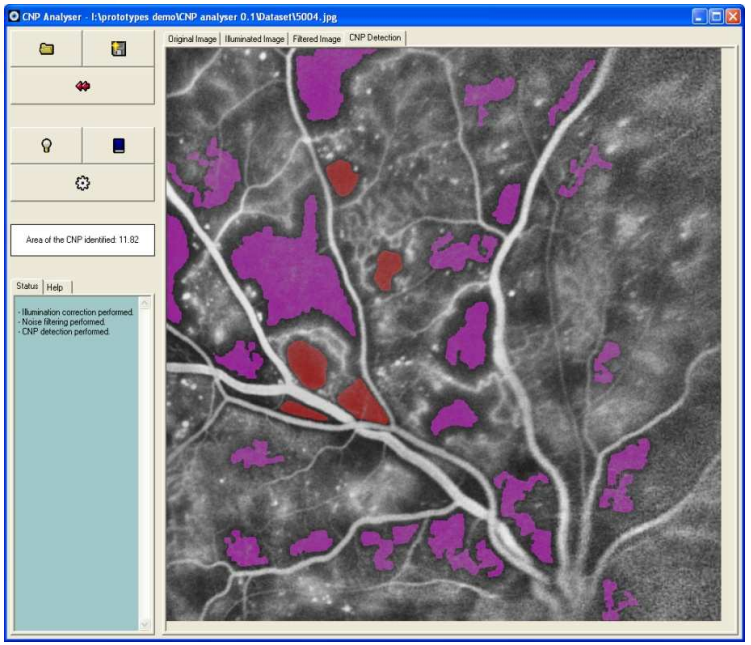
J. Sivaswamy , et. al., (Book chapter) Biomedical Engineering Systems and Technology, 2008

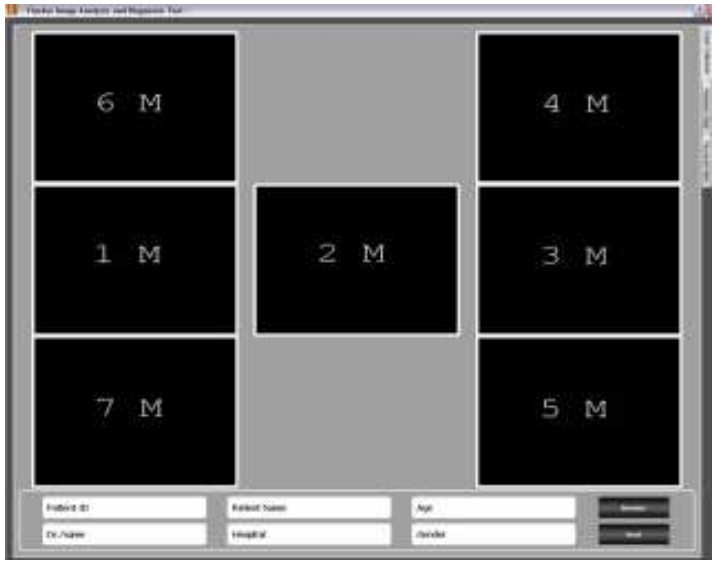
In association with LVPEI, Hyderabad

Developed interactive tools



DR Annotation & Analysis tool





CNP Annotation and Analysis Tools

Thank you
For your time
and to
DST for research funding