

A.I. in Retinopathy Healthcare

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Imperial College London



Outline

- Overview of Retina Pathologies
 - Age related Macular Degeneration (AMD)
 - Diabetic Retinopathy (DR)
 - Glaucoma
- AI in Retinopathy Healthcare and Research

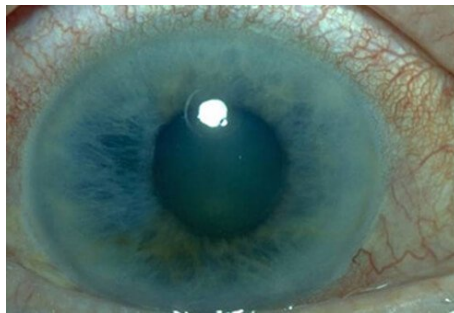
disclaimer... I am not a clinician

with that said...

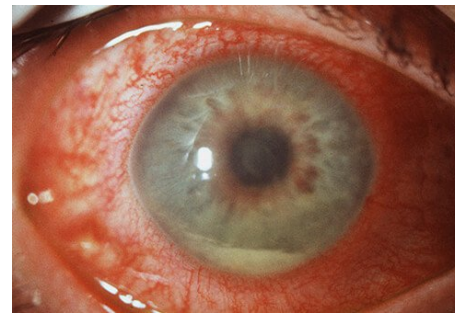
lets proceed :D

Retinal Pathologies

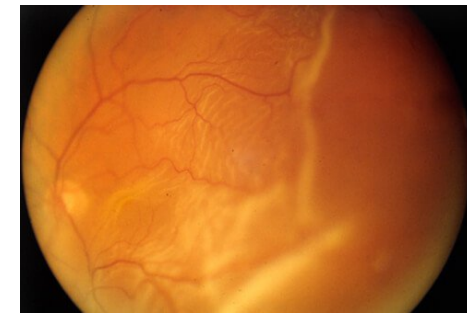
Glaucoma



Uveitis



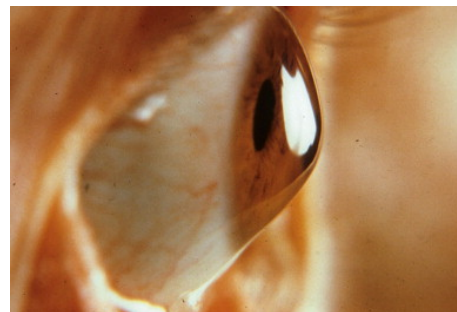
Retinal Detachment



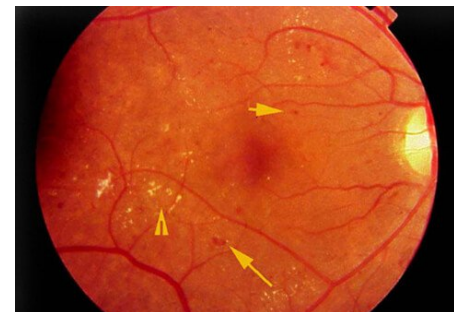
Cataracts



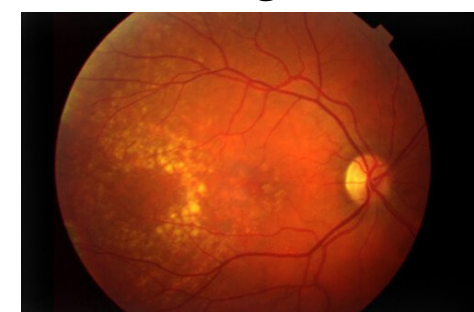
Keratoconus



Diabetic Retinopathy



Age-related
Macular Degeneration

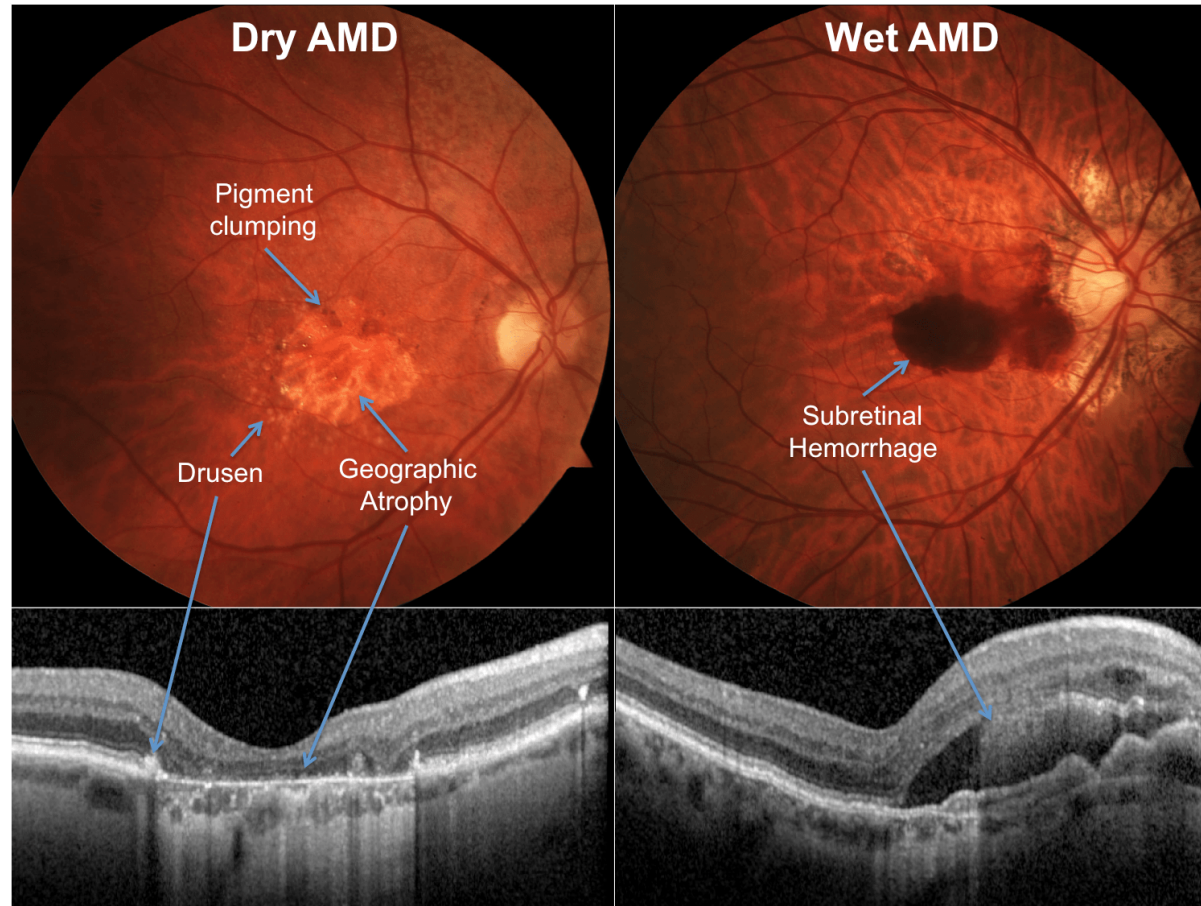


Age-related Macular Degeneration (AMD)



Age-related Macular Degeneration (AMD)

Common
90% cases
Untreatable



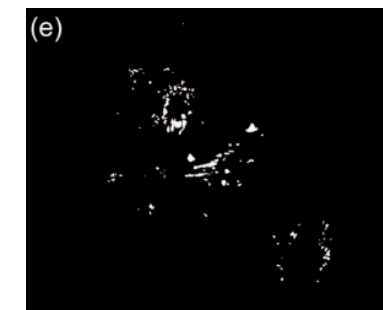
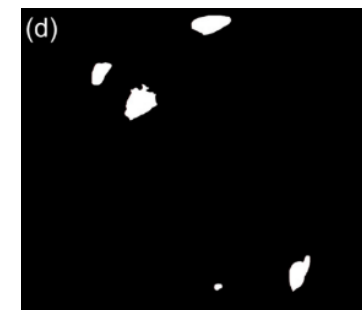
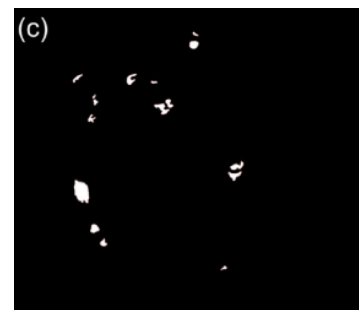
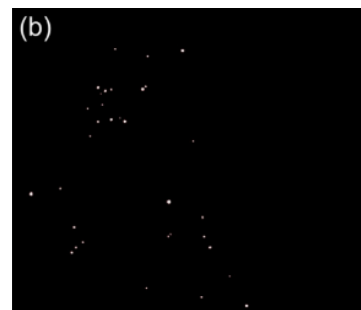
Uncommon
10% cases
Treatable

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Diabetic Retinopathy

Healthy	Non-Proliferate DR			Proliferate DR
	Mild	Moderate	Severe	
No apparent abnormalities	Presence of MAs only	More than just MAs, but less than Severe NPDR	<ul style="list-style-type: none"> Intraretinal HEs Venous beading Intraretinal microvascular abnormalities No signs of PDR 	Either or both; <ul style="list-style-type: none"> Neovascularization Vitreous or pre-retinal HE

progression →



Microaneurysm (MA)

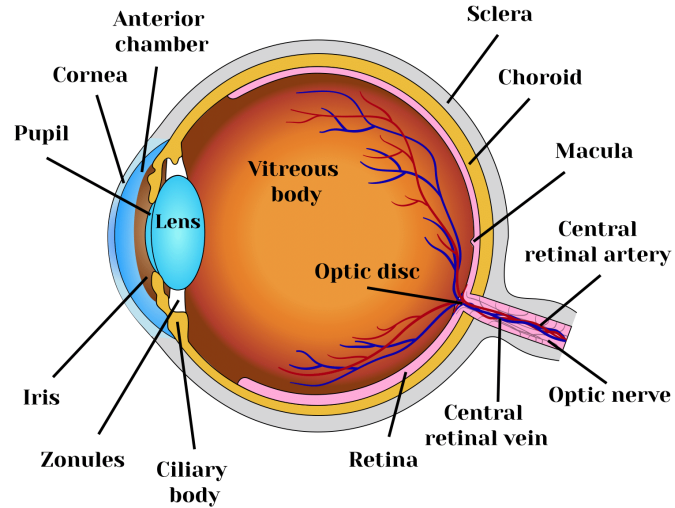
Hemorrhages (HE)

Soft Exudates (SE)

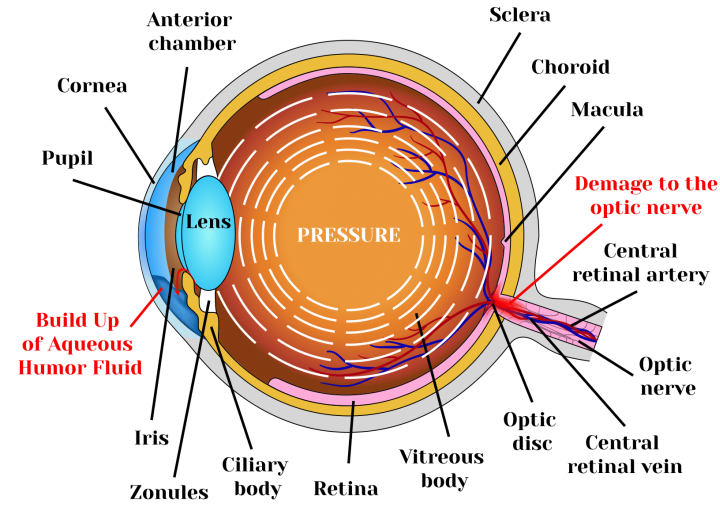
Hard Exudates (EX)

Glaucoma

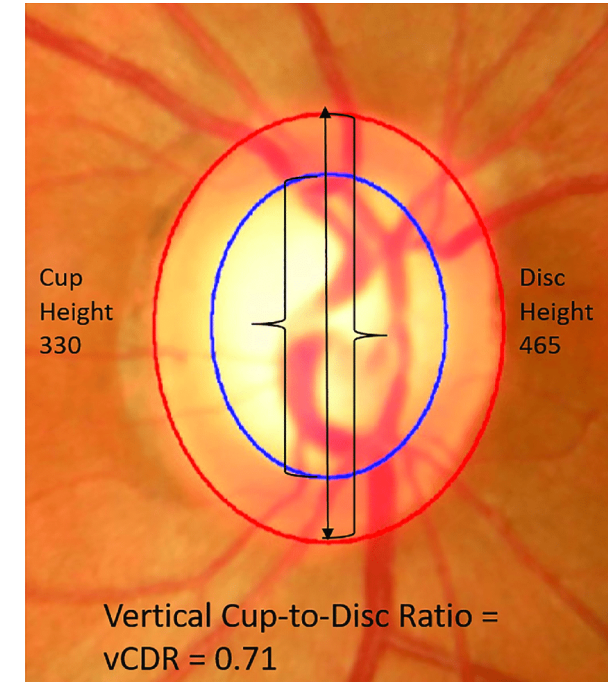
Normal Vision



Glaucoma

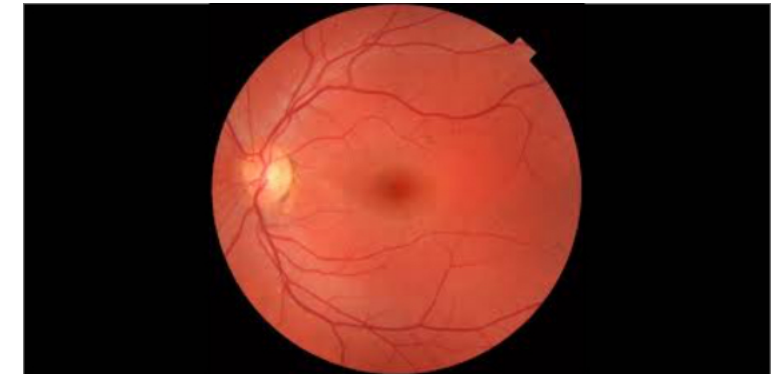


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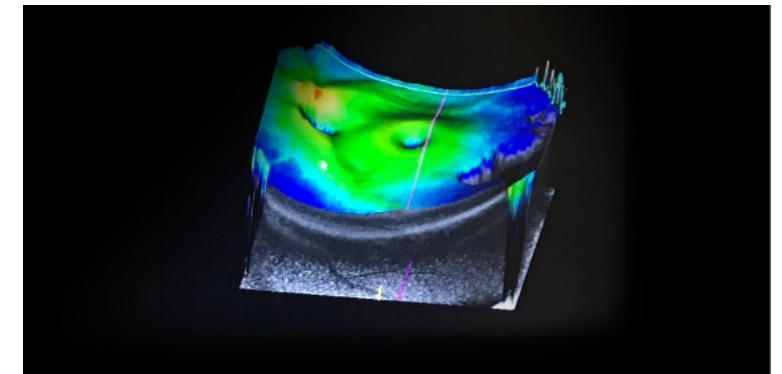


Maccormick et al. (2019)

Clinical Screening



Retinal Fundus Image



Optical Coherence Tomography Image

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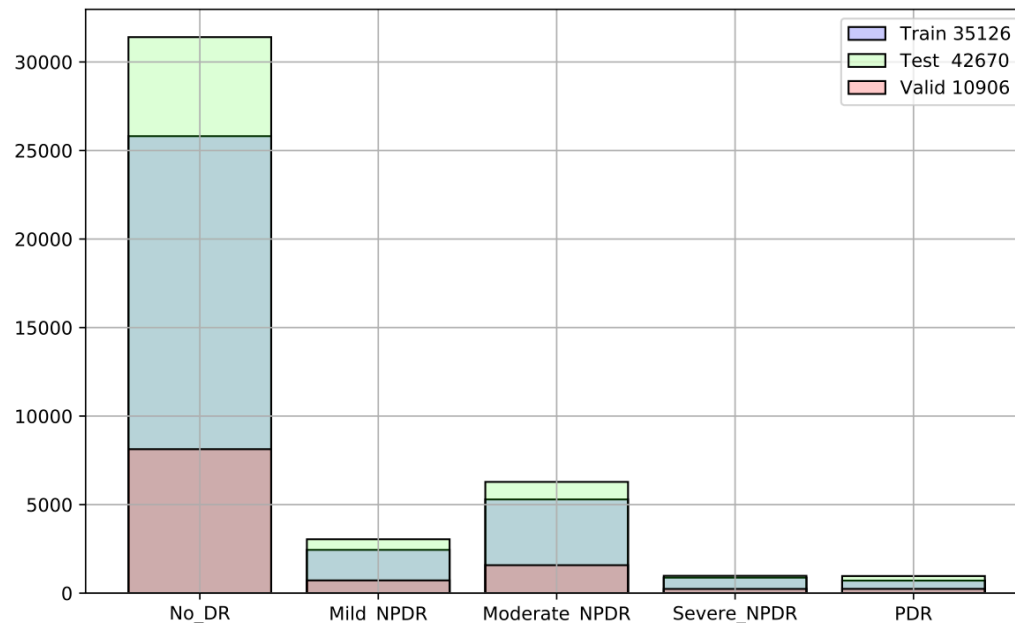
AI in Retinopathy Healthcare

AI-assisted medical screening and diagnosis based on images are currently evolving. Application of this technology in ophthalmology is currently focused mainly on the diseases with a high incidence, such as diabetic retinopathy (DR), age-related macular degeneration (ARMD), glaucoma, retinopathy of prematurity (ROP), age-related or congenital cataract, and retinal vein occlusion (RVO).

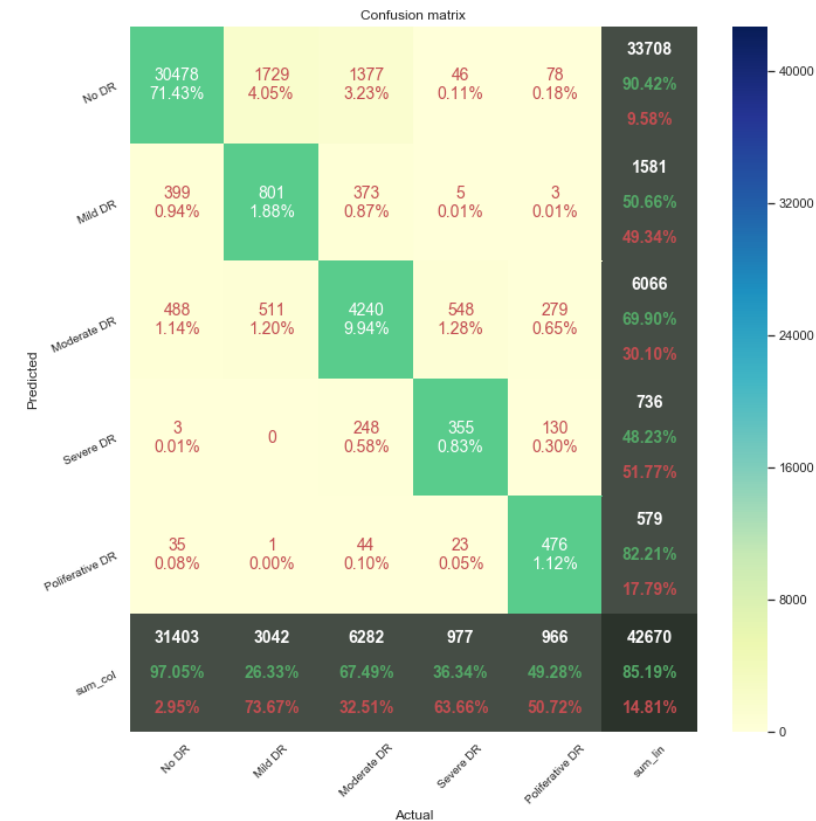
-- Artificial intelligence in diabetic retinopathy: A natural step to the future
Srikanta Kumar Padhy
Indian J Ophthalmol. 2019 Jul; 67(7): 1004-1009

Research Themes

- retinal pathology detection via classification

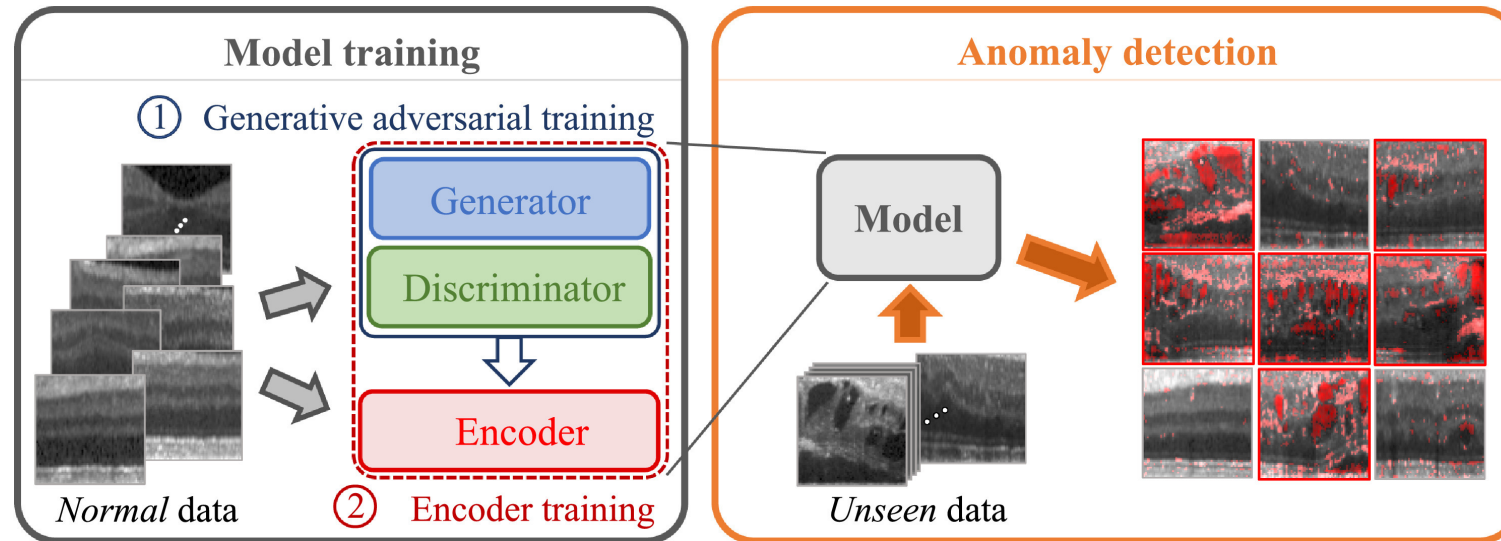


EyePACS: 35126 colour fundus images



Research Themes

- retinal pathology detection via anomaly detection



AnoGAN and f-AnoGAN

Schlegl et al. (2017), IPMI 2017, pp. 146-57
 Schlegl et al. (2019), Medical Image Analysis 54, pp. 30-44

Research Themes

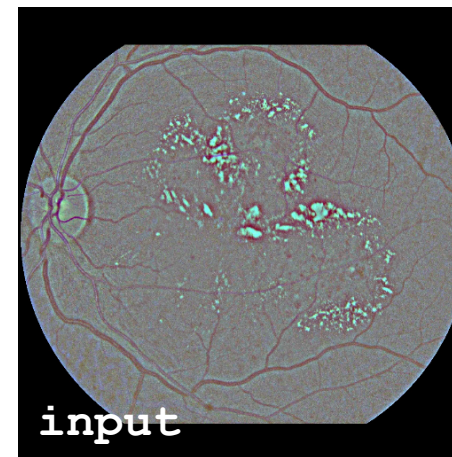
- retinal pathology segmentation



$f1 = 0.821$ $auc = 0.918$

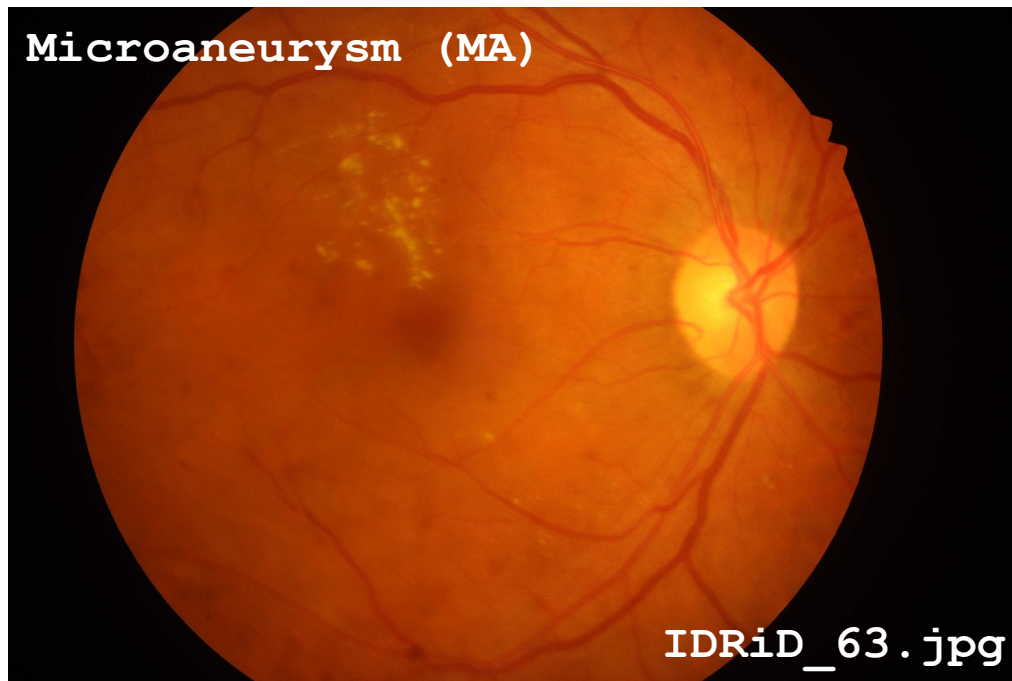
black: true negative
white: true positive

blue: false negative
red: false positive



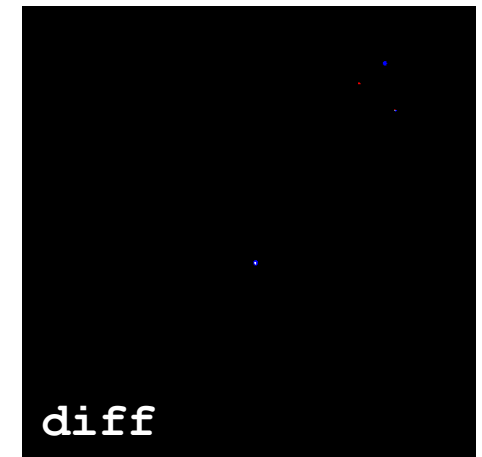
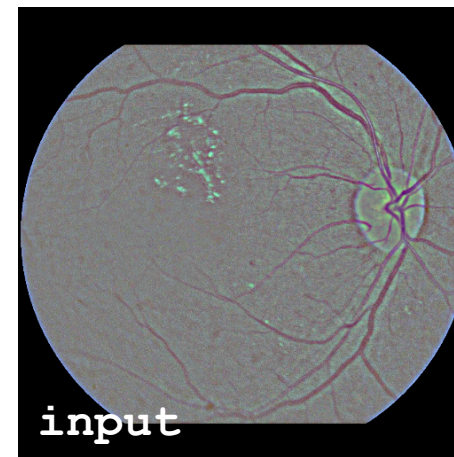
Research Themes

- retinal pathology segmentation



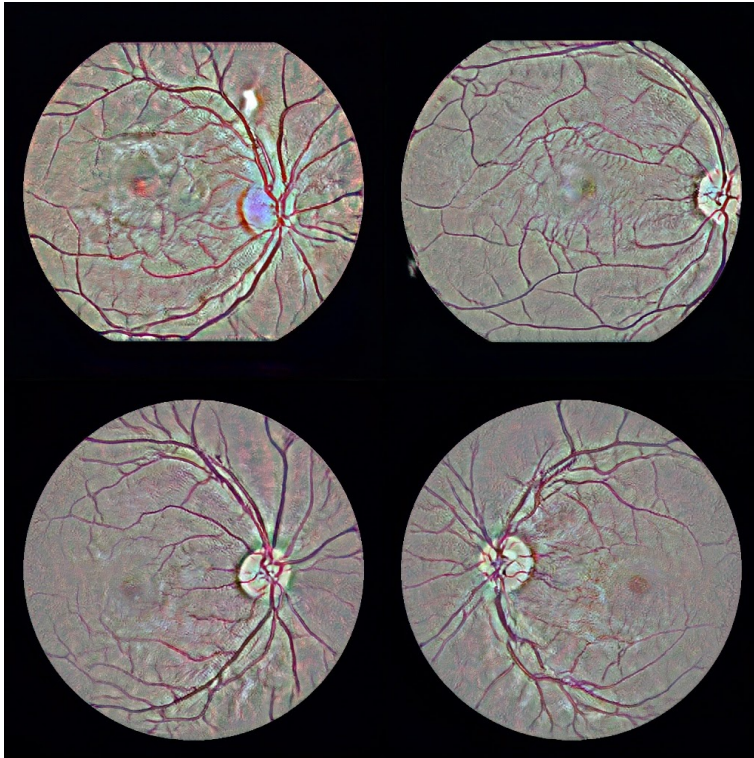
f1 = 0.197 auc = 0.227

black: true negative blue: false negative
white: true positive red: false positive

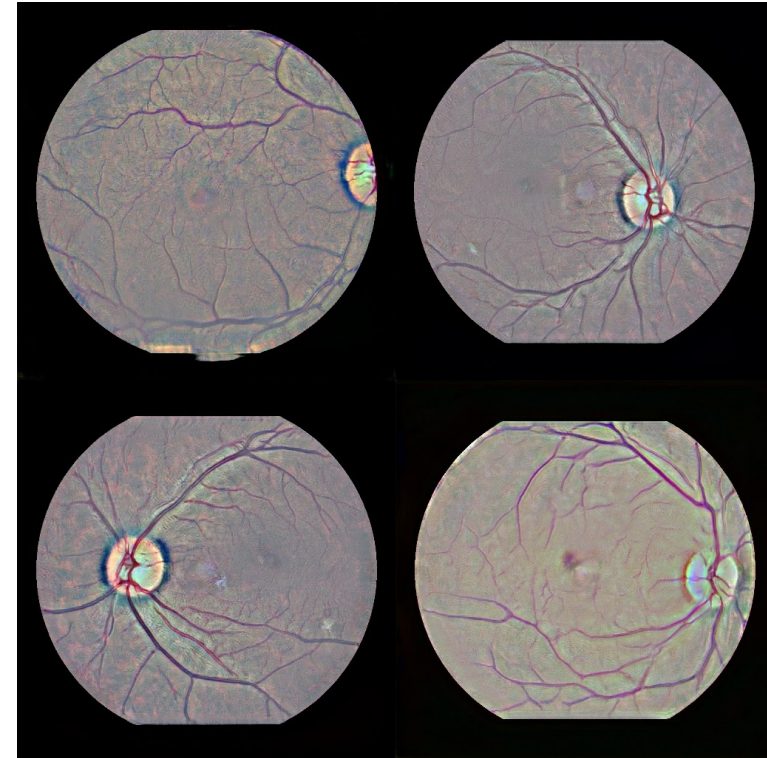


Research Themes

- retinal pathology synthesis



Mild NPDR



Research Themes

- retinal pathology synthesis

Class	Baseline	Weighted Sampling	Weighted Loss	GAN Synthesis
0	97.03	97.33	94.59	98.67
1	3.48	2.56	5.63	3.94
2	52.86	49.15	50.44	53.52
3	54.05	28.57	37.62	22.74
4	39.28	45.11	47.58	43.49
avg	81.84	80.63	79.29	82.19

Table 7.1 Top-1 classification results on each dataset balancing method

Special thanks to...



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**Imperial College
London**



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Questions?

