Artificial intelligence in ocular medicine: Seeing into the future

June 13 – July 1, 2019

Event planning committee

Committee Chair: Rajat N. Agrawal, MD, MS, CEO Retinal Global

Siamak Yousefi, PhD, director of the Data Mining and Machine Learning (DM2L) Laboratory, University of Tennessee Health Science Center

Consultants:

- Michael David Abramoff, MD, PhD, FARVO, Ophthalmology & Visual Sciences, University of Iowa Hospitals & Clinics, ID
- Michael F. Chiang, MD, Ophthalmology and Medical Informatics, Oregon Health & Science University
- Susan C. Orr, OD, Chief Executive Officer, Notal Vision
- Arthur H. Shedden, Jr., MBA, MD, Senior Safety Officer, Johnson & Johnson Vision Care, Inc.
- Daniel SW Ting, MD, PhD, Singapore National Eye Centre

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Live webinar sessions

These sessions will be presented live using WebEx webinar technology. The presentation times vary due to our global audience. Attendees will be able to ask questions via the platform. All live sessions will be recorded and available online within 48 hours.

An extension may need to be downloaded and installed on your web browser. Test your system now: https://www.webex.com/test-meeting.html

Session 1: Event opening session

Thursday, June 13: 3:30 – 4:30pm EDT

Featured speaker
Dimitri Azar, MD, MBA, Senior Director of Ophthalmic Innovations, and Clinical Lead, Ophthalmology Programs, Alphabet Verily Life Sciences; Distinguished University Professor, BA Field Chair of Ophthalmological Research, and Former Medical School Executive Dean, University of Illinois College of Medicine

Session 2: AI for use in ophthalmic clinical care panel discussion

Thursday, June 19: Time (to be determined)

Speakers
Michael Abramoff, MD, PhD, FARVO, Ophthalmology & Visual Sciences, University of Iowa Hospitals & Clinics, ID, David D Draper, RN, National Institutes of Health

Session 3: Developing AI algorithms for ophthalmic care and research

Friday, June 20: Time (to be determined)

Speakers
Coming soon

Session 4: Moving your AI technology from the lab to the clinic: Lessons learned

Thursday, June 25: Time (TBD)

Featured speaker

Brad Cunningham, MSE, RAC, Associate Director (acting), Office of Health Technology 1, Center for Devices and Radiological Health Commander, USPHS.

Session 5: Event closing session

Thursday, June 27: Time TBD

Featured speaker

TBD

Speakers may be changed due to unforeseen circumstances.

Instructional presentations

These presentations were recorded during the 2019 Education Course: Artificial intelligence – from benchtop to bedside. They will be available to attendees for the duration of the online event to view at their own pace and convenience.

General Introduction on AI in healthcare

Michael David Abramoff, MD PhD, FARVO

General Introduction on AI in healthcare. We will briefly sketch the history of AI in healthcare, review the different types of medical AI, including research focused versus clinically focused AI, autonomous vs assistive AI, explainable vs non-explainable AI. We will then introduce the consequences these have on AI algorithm, efficacy, and patient safety where applicable.

Overview of deep learning algorithms (DLSs) in medical imaging for Ophthalmology

Daniel SW Ting, MD, PhD, Singapore National Eye Centre

In medicine, the most robust deep learning algorithms have been from image-centric specialties, including radiology, dermatology, pathology and ophthalmology. In ophthalmology, DLSs were able to effectively detect diabetic retinopathy, glaucoma, age-related macular degeneration (AMD), retinopathy of prematurity (ROP), refractive error, and cardiovascular risk factors based on colour fundus photographs. Additionally, several retinal conditions (e.g. drusens, neovascular AMD, diabetic macular edema) can be detected accurately using optical coherence tomography (OCT). This presentation will provide a brief overview of the current state-of-art deep learning systems in Ophthalmology.

Global Eye Health: Disease Burden and Clinical Unmet Need

Tien Y Wong, FRCS, PhD, FARVO, Singapore National Eye Centre

Visual impairment (VI) is a major public health problem, associated with reduced quality of life, and increased frailty risk. Globally, 400 million suffer from VI. The five major causes of VI are under-corrected refractive error, *cataract, glaucoma, age-related macular degeneration and diabetic retinopathy. These conditions will increase as the global population ages. About 80% of VI and these conditions are preventable if detected early. Hence, screening programs for VI and major eye diseases are critical to prevent blindness. Artificial intelligence (AI) has the potential to significantly enhance and impact on screening programs for VI and eye diseases, and thus to impact on global blindness.*

How does AI fit in with the current eye practices in United States?

James C Folk, MD, University of Iowa

A-I could fit as a "doctor extender" in current eye practices. Cameras with algorithms could be placed in multiple locations such as a primary care office, a community health center or even a pharmacy. Automation would send the results to the electronic medical records of the primary care doctor and the eye doctor. Depending on the population and the A-I results, about 10% of patients would need to see an eye doctor whereas 90% could be safely screened again in one year. The same model could also be used for other eye diseases.

Algorithm Design: Technical network (CNNs), software, CPU/GPU/TPU

Ranya Habash, MD, Bascom Palmer Eye Institute, Chief Medical Officer, Everbridge

This is a technical overview of algorithm design, which resembles the biological structure of neural networks in cognitive function. We will explore the mathematics behind Hebb's rule, mapping inputs to outputs, and backpropogation to calculate weights used in powering multilayer neural networks. We will compare the makeup of these networks to the brain's own methods for learning and memory.

The need for clinical (and trialist) commonsense in AI algorithm design

Samuel G Finlayson, MS, Harvard Medical School and MIT

Recent advances in AI make it historically easy to train machine learning models that achieve high accuracy on a range of tasks. But are they actually learning what we think they are? In this session, we'll review the machine learning pipeline with a focus on commonly neglected failure mechanisms and the steps we can take to mitigate them. We'll discuss (and contrast) concepts such as label leakage, dataset shift, overfitting, interpretability, model inspection, and adversarial robustness. In doing so, we'll try to develop a cohesive framework for ensuring our models will behave as in intended when deployed in real, prospective clinical scenarios.

Machine Learning - Diabetic Retinopathy and Beyond

Naama Hammel, MD, Clinical research scientist, Google LLC

This talk will cover:

- *Principles and best practices of machine learning research*
- *Deep learning systems for detection of diabetic retinopathy and other eye diseases*
- *What's next? Machine learning applications and future research directions in ophthalmology*

DLSs for Glaucoma and Tele-Ophthalmology

Louis R Pasquale, MD, FARVO, Icahn School of Medicine, Mount Sinai Health System

This presentation will discuss 3 gaps in glaucoma addressed by artificial intelligence (AI).

Gap 1: Glaucoma is an optic nerve disease categorised by excavation and erosion of the neuroretinal rim that clinically manifests itself by increased optic nerve head (ONH) cupping. Yet, because the ONH area varies by *fivefold, there is virtually no cup to disc ratio (CDR) that defines pathological cupping, hampering disease detection. AI is capable of detecting discs above a specified cup-disc ratio although it not yet able to identify the disc associated with manifest visual field loss*

Gap 2: The outputs from visual field tests typically provide reliability parameters, age-matched normative comparisons and summary global indices, but more detailed analysis of this functional data is lacking. An AI algorithm called archetype analysis is capable of decomposing the total deviation plot of a visual field into components and provide weighting coefficients regarding any regional deficits.

Gap 3: Several computer programs to detect VF progression exist, ranging from assessment of global indices over time to point-wise analyses, to sectoral VF analysis; however, these approaches are often not aligned with clinical ground truth nor with one another. AI algorithms can detect VF progression earlier than these conventional computer strategies and produces results that are more in line with clinical ground truth.

Comparison of Deep Learning Systems for Age-related Macular Degeneration (AMD)

Neil M. Bressler, MD, Johns Hopkins, Applied Physics Laboratory and University School of Medicine, Wilmer Eye Institute

Deep learning may be used for public screening or monitoring of AMD in developed and developing countries worldwide – assisting with referring individuals to health care practitioner when indicated and feasible. Although there are no FDA approved products currently, a variety of programs developed appear feasible for screening or monitoring with differences based on on training sets and methods used. There is also the potential of deep learning to assist physicians in longitudinal care for individualized, detailed risk assessment in AMD. These items will be discussed during this presentation.

Artificial intelligence for Retinopathy of Prematurity (ROP) detection

Michael F Chiang, MD, Ophthalmology and Medical Informatics, Oregon Health & Science University

This presentation will discuss motivations, challenges, and solutions regarding applications for machine learning and deep learning for retinopathy of prematurity (ROP) diagnosis. Concepts generalizable to other disease states will be discussed.

Deep Learning Systems for Retinal Disease using Optical Coherence Tomography

Pearse Andrew Keane, MD, FRCOphth, Moorfields Eye Hospital and UCL Institute of Ophthalmology

Deep learning systems use artificial neural networks – so-called because of their superficial resemblance to biological neural networks – as computational models to discover intricate structure in large, high dimensional datasets. Since 2012, deep learning has brought seismic changes to the technology industry, with major breakthroughs in areas as diverse as image captioning, speech recognition, natural language translation, robotics, and even self-driving cars. In 2015, Scientific American listed deep learning as one of their "world changing" ideas for the year.

In July 2016, Moorfields Eye Hospital in London announced a formal collaboration with DeepMind, arguably the world's leading organisation for AI research. This collaboration has involved the application of deep learning to >1 million anonymised OCT scans with the aim of automating the diagnosis of macular diseases such as age-

related macular degeneration (AMD) and diabetic retinopathy (DR). Preliminary results suggest that this algorithm is on a par with experienced retinal specialists in the triaging of these conditions. In addition to performing classification tasks (e.g., screening, triage, diagnosis), the Moorfields-DeepMind algorithm is capable of performing automated segmentation for a wide range (>10) of retinal morphologic parameters on OCT (segmentation is a term used in computer vision research which describes the delineation of specific features on an image). I will give an overview of this system and its application to retinal OCT scans.

Potential challenges of AI in OCT imaging

Bhavna Josephine Antony, PhD, Research Scientist, IBM Research Australia

AI for medical image analysis and computer vision vary as there are distinct problems faced in each domain. OCT image analysis is confounded by the varying image resolution, acquisition protocols and other image characteristics. Here, I will briefly illustrate some of the main challenges that AI for OCT imaging is facing currently and will have to overcome soon.

Artificial Intelligence Eye Screening using Smartphones: The Good, the Bad, and the Ugly

Kaushal Solanki, Phd, CEO Eyenuk, Inc.

Artificial intelligence (AI) systems are gaining attention for population eye screening. Smartphone-based retinal fundus cameras are attractive for artificial intelligence eye screening, especially for autonomous diabetic retinopathy screening, which is also supported by promising clinical evidence. Smartphone-based fundus cameras are portable and inexpensive, and the smartphone also provides a natural software and communication platform using apps that are easy to use. To set up real-world screening programs that utilize smartphone fundus photography and cloud-based AI analysis, there are a few considerations that must be addressed, which include (a) whether dilation of all or subset of patients is possible, (b) training of photographers for the cameras that operate differently, (c) availability of network (3G/LTE or Wifi), and (d) use of camera mounts. Therefore, institutions, non-profits, or Governments interested in setting up screening programs using the smartphone-based photography must (i) use AI systems that have been extensively tested in real world, (ii) incorporate extensive photographer training program and continuously test the photographer skills, (iii) carefully validate the end-to-end system in their setup via initial pilot implementation, (iv) use portable camera mounts, and (v) consider dilating all or specific population groups (eg, older age groups or with smaller pupil). In other scenarios a tabletop fundus camera with AI is still the best option. The future does hold great promise for portable and/or smartphone-based fundus imaging to be truly clinic-ready for population eye screening using artificial intelligence.

Autonomous AI and Quality Management Systems

David Vidal, VP of Quality & Regulatory Affairs, IDx

This presentation covers the combination of Regulations, Standards, Frameworks, and Guidance documents used for an autonomous AI Quality Management System (QMS), including QMS recommendations for future guidelines related to autonomous AI.

AI technology implementation: productizing autonomous diagnostic AI

Meindert Niemeijer, PhD, IDx

This presentation will cover some of the pitfalls and practical considerations associated with the productization of an autonomous diagnostic AI algorithm. Including such topics as algorithm training, verification and validation. The importance of algorithm explainability and the need for an independent reference standard to establish truth.

The submission and examination process of an AI eye product by US FDA

CDR Brad Cunningham, MSE, RAC, Chief Diagnostic and Surgical Devices Branch, Office of Device Evaluatoin, Center of Devices and Radiological Health

This presentation reviews the submission and examination process of an AI eye product by U.S. FDA.

AI outside the developed world: applications and regulatory aspects

Rajat N Agrawal, MD, MS, CEO Retinal Global

The presentation will highlight the pathways and likely challenges that AI developers focused on ophthalmology systems will face when working to implement systems in underdeveloped areas of the world. The presentation will highlight the current systems in place in some of these underdeveloped countries and provide suggestions for access. Regulations exist in few of these underdeveloped countries, which may be a boon for AI platforms in implanting their systems, if they already have an approval from leading regulatory agencies such as FDA. On the other hand, if regulatory systems exist, these are slow to react and approve, which delays the pathway to final approval and implementation of systems in such areas. The presentation will highlight the process, with an example to highlight the steps and likely challenges.

The ethical implications of AI

Susan C Orr, OD, CEO, Notal Vision

This presentation covers the ethical issues surrounding the development and use of AI in clinical care. Issues such as bias, explainability, harmlessness, economic impact and responsibility will all be discussed.

Technology showcase videos

These videos showcase AI-enabled products in development for use in eye and vision care. Hear directly from investigators located across the globe who are developing these products. The videos will be available to attendees for the duration of the online event to view at their own pace and convenience.

Corneal disease

Customised Vision for Cataract Patients

Contact: Harilaos Ginis, h.ginis@athenseyehospital.gr

Cataract surgery, besides necessary in order to restore functional vision in cataract patients is a unique opportunity to reform the optical system of the eye.

Multifocal IOLs (of various types) provide simultaneously far, near and (in some cases) intermediate vision. These IOLs are (by design) an optical and functional compromise, in the sense that none of the foci is perfect and the patient is expected to get accustomed to the deteriorated image quality. Clinical research on multifocal IOLs is centered around developing patient selection criteria. This projects recruits methods from Artificial intelligence to identify the best solution for each patient among the various available IOL designs. Moreover, it may lead to a methodology for designing customized IOLs for each individual patient.

Customised Vision for Cataract Patients will improve outcomes in premium IOL implantations.

It will efficiently identify patients that are likely to experience difficulties with multifocality and reduce the burden for IOL explantation surgeries for clinics and physicians.

Partners: InfiniteVision Optics, http://www.infinitevisionoptics.com; Athens Eye Hospital, http://www.athenseyehospital.gr; iCube - University of Strasbourg, http://icube.unistra.fr

Disease(s): Intraocular lens design for cataract surgery.

In vivo confocal microscopy

Contact: Pedram Hamrah, MD and Dilruba Koseoglu, MD, dilruba33@yahoo.com

Corneal imaging on a cellular level including nerve and immune cell analysis, diagnosis of keratitis (ex. fungal keratitis) and corneal dystrophies. Artificial intelligence is introduced for the automated analyses of corneal nerves and micro-neuroma.

Disease(s): Corneal disease

SpecifEye Ectasia Match Percentage

Contact: Ibrahim Seven, https://www.optoquest.net.

The ectasia match percentage is derived from SpecifEye's deep learning model. This model was trained using stable post-LASIK eyes as the control group and confirmed post-LASIK ectasia eyes as the diseased group. The model uses raw tomography files (ele.csv: Pentacam) and age as inputs and utilizes proprietary data extraction and preprocessing techniques. Following the training, the model was tested using independent datasets for control and confirmed ectasia groups. The sensitivity (True positive/True Positive + False Negative), specificity (true negative/false positive + true negative), and accuracy (true positive + true negative/ positive + negative) values of the model are 0.96, 0.95, and 0.95, respectively.

The model calculates a percentage for each eye. This percentage defines how strongly the model classifies the eye into the ectasia group. The higher the percentage, the higher the likelihood the features of the imported eye match the preoperative features of eyes that developed post-LASIK ectasia.

Disease(s): Corneal disease, Low vision

Visionome Website-based Platform

Contact: Haotian Lin, MD, PhD, haot.lin@hotmail.com

The system was designed to address four typical clinical scenarios: 1) mass screening to distinguish between normal and abnormal eyes, 2) comprehensive clinical triage to detect 14 lesion locations and ocular structures, 3) hyperfine diagnostic assessment of 22 (10 types) pathological features, and 4) multipath treatment planning with consideration of 7 treatment options.

Disease(s): Corneal disease

Diabetic retinopathy

AIDRSS

Contact: Pradeep Walia, pwalia@artelus.com, Rajarajeshwari K, kraji@artelus.com, Rajarajalakshmi K, rkodhandapani@artelus.com or Amod Nayak, doc_amodnayak@yahoo.co.in

AI on Chip Offline AI solution to screen people in remote and inaccessible areas for Diabetic Retinopathy. The key benefit to our solution is that they are no longer dependent on a working internet to screen patients for various health condition that can be prevented with early intervention. In addition, since the AI device is portable, our customers can increase their geographical reach and screen more patients.

Enabling Global screening for diseases that can be tackled with early detection is with the help of an AI product that would complement the knowledge, and assist the clinician in making faster and accurate diagnosis.

Disease(s): Diabetic retinopathy (DR)

EyeArt
Contact: Kaushal Solanki, eyeart@eyenuk.com

The first part of the video presents how Eyenuk's EyeArt AI eye screening system is helping address the growing need for diabetic retinopathy screening. It highlights the sources of funding, the patents covering the technology, and the extensive real world clinical validation of the EyeArt system. The second part of the video is an interview with Dr. Jennifer Lim (Univ. Of Chicago) on EyeArt's prospective, multi-center, pivotal clinical trial, where she talks about how the EyeArt system was trained and tested, how the clinical trial was designed, and explains the sensitivity of 95.5%, specificity of 86.5% at imageability of 97% for detecting referable diabetic retinopathy achieved by the EyeArt system. The final part of the video is an interview with Prof. Dr. Med. Thomas Haak (Diabetes Center Mergentheim, Germany) where he talks about implementation of EyeArt in their diabetes clinic and the positive impact it is having on their patients.

Disease(s): Diabetic retinopathy (DR)

EyeStar
Contact: Simon Barriga, PhD (CEO) sbarriga@visionquest-bio.com

VisionQuest Biomedical has developed *EyeStar, an artificial intelligence (AI) software system to screen for diabetic retinopathy (DR) and other retinal diseases. EyeStar is being used clinically in Mexico at* Clinicas del Azucar *since 2016. EyeStar has been used to screen over 16,000 diabetics for DR in Mexico achieving excellent performance results. VisionQuest is working with retinal camera manufacturers to deploy EyeStar in pharmacies, primary care clinics, and diabetes care clinics.*

EyeStar is a patented AI software system that uses image processing, deep learning, and image quality analysis to screen for diabetic retinopathy. EyeStar has been deployed in 15 diabetes clinics in Mexico where it has been used to screen over 16,000 diabetic patients for eye disease and prevented over 1,000 of those patients from going blind. EyeStar works as follows: Images are captured without pupil dilation at the point of care using tabletop or portable retinal cameras. Images are then uploaded to the cloud where EyeStar processes them and produces a result in less than 2 minutes. For 25% of the patients, EyeStar will recommend a referral to eyecare due to the presence of retinal disease. The remaining 75% of the patients come back in one year to repeat the test. EyeStar has achieved sensitivity of 95% with specificity of 88%, and 75% workload reduction for the physician.

Disease(s): Diabetic retinopathy (DR)

IDx-DR
Contact: Laura Shoemaker, https://www.eyediagnosis.net/contact

IDx-DR is intended for use by health care providers to automatically detect more than mild diabetic retinopathy (mtmDR) in adults (22 years of age or older) diagnosed with diabetes who have not been previously diagnosed with diabetic retinopathy. IDx-DR is indicated for use with the Topcon NW400.

Disease(s): Diabetic retinopathy (DR)

RET-AI
Contact: Rodrigo Abreu-Gonzalez, rodrigoabreug@gmail.com

The system has been trained to perform an automatic quality control on the image, and generate a patient profile showing a series of predictions about physiological parameters such as age and sex, as well as inferring the degree of diabetic retinopathy present.

Disease(s): Diabetic retinopathy (DR)

Dry eye

Dry AI
Contact: João Victor Pacheco Dias, jvictordias@gmail.com

A mobile app to assist physicians on assessment of dry eye as an alternative of noninvasive tear break-up time. Using a Convolutional Neural Network for feature extraction with a Bidirectional LSTM for sequencing the TBUT it's possible to inform the physician in some seconds about the patient eye conditions.

Disease(s): Dry eye syndrome

Glaucoma

An Artificial Intelligence Method to Assist Clinician to Assess Visual Field Progression in Glaucoma
Contact: Mengyu Wang, Mengyu_Wang@MEEI.HARVARD.EDU

We have developed an artificial intelligence approach using archetypal analysis to detect visual field progression in glaucoma. The archetype method can detect visual field progression more accurately than existing methods with respect to the clinician assessment. Compared with existing approaches, our archetype method provides not only progression status but also quantifies progressed regions. Tracking pattern changes over time by our archetype method can assist clinicians to better evaluate VF series for progression detection.

Publication link: https://iovs.arvojournals.org/article.aspx?articleid=2723059

Disease(s): Glaucoma

Diagnostic Innovations in Glaucoma Support System (DIGSs) Deep Fundus Photo Glaucoma Detection
Contact: Mark Christopher, mark.allen.christopher@gmail.com

The product is a deep learning-based system to estimate the probability of glaucomatous optic neuropathy given a color fundus photo of the optic nerve head. This product is intended for use in screening applications and to provide decision support for the clinical review of fundus photos for glaucoma diagnosis and monitoring. For more information about this product, see the related publication (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6232132/) and go to https://shileyeye.ucsd.edu/research/computational_ophthalmology.

Disease(s): Glaucoma

Diagnostic Innovations in Glaucoma Support System (DIGSs) Deep Structure-Function Prediction
Contact: Christopher Bowd, cbowd@ucsd.edu

The product is a deep learning based system to predict visual field (VF) function from spectral domain optical coherence tomography (SDOCT) images. Based on SDOCT imaging of the macula and optic nerve head, deep learning models are used to estimate global 24-2 and 10-2 VF summary metrics (mean deviation and pattern standard deviation) as well as visual function at finer scale (sectoral and individual test point pattern deviation). This product is intended to supplement time-consuming VF testing to help clinicians identify patients likely to undergo functional loss. For more information about our group, please go to https://shileyeye.ucsd.edu/research/computational_ophthalmology.

Disease(s): Glaucoma

Multiple disease states

A.I./Machine Learning tools, with the current focus on neovascular AMD and diabetic eye disease
Contact: J. Jill Hopkins, MD, FRCSC, Global Head, Personalized Health Care – Ophthalmology, Product Development, Personalized Health Care (PDP), hopkins.jill@gene.com

Genentech/Roche has a deep interest and investment in Personalized Healthcare to bring novel solutions to patients with retinal diseases. We are applying machine learning and advanced analytics on advanced imaging and high quality data at scale, initially derived from our vast clinical trial database. This wealth of longitudinal, multimodal data has been annotated, integrated and curated so that machine learning tools can be utilized in the effort to develop new insights in to retinal disease and treatment response to bring benefit to patients. We will collect additional data from our ongoing phase 3 programs as well as through significant collaborations and partnerships.

As part of the large Ophthalmology Personalized Healthcare Initiative, Roche/Genentech are developing A.I./Machine Learning tools, with the current focus on neovascular AMD and diabetic eye disease, to predict and prevent vision loss. These algorithms can be used by ophthalmologists to deliver more personalized healthcare solutions to patients with retinal disease.

We are committed to the utilization of these tools and accompanying insights to discover new therapeutic targets and develop better treatment paradigms. We have specific interests in prediction of disease progression and response to therapy, and seek novel data inputs and well validated algorithms that will further individualized approaches to disease based on large scale data inputs. Our program is committed to evaluating clinical utility and demonstrating benefit to bring meaningful change to patient care and outcomes.

For more information about Personalized Healthcare at Roche, please visit our website.

Disease(s): neovascular AMD and diabetic eye disease

AI-Multifractal OCT
Contact: Samarendra Mohanty, smohanty@nanoscopetech.com

The product obtains multifractality in spatial variation from intensity OCT image and temporal variation in phase OCT image. The features from multifractality OCT are derived using AI platform for diagnosis of different ocular diseases.

Disease(s): Age-related macular degeneration (AMD), Corneal disease, Diabetic retinopathy (DR), Glaucoma, Low vision, Retinal disease (other than DR)

AI for classification of retina database

Contact: Miguel A. Zapata, mazapata@optretina.com

Hybrid system using AI form classification of huge databases of retinal images (by the moment centered in retinographies)

Disease(s): Age-related macular degeneration (AMD), Diabetic retinopathy (DR), Glaucoma, Retinal disease (other than DR)

EyeWisdom

Contact: Leon Li, wei.li@vistel.cn

More than 4 categories and 20 kinds of ocular diseases could be recognized with EyeWisdom. EyeWisdom is designed to help general practitioners to distinguish the patient with ocular disease from the heathy ones.

Disease(s): Age-related macular degeneration (AMD), Diabetic retinopathy (DR), Glaucoma, Retinal disease (other than DR)

Deep Learning for Automated Screening and Semantic Segmentation of Age-related and Juvenile Atrophic Macular Degeneration

Contact: Zhihong Jewel Hu, PhD, zhihonghu29@gmail.com

The video shows our work for the automated screening and semantic segmentation of age-related and juvenile atrophic macular degeneration using an artificial intelligence (AI) technique of deep learning. It also demonstrates the derived applications of the deep learning algorithms for the assessment and prediction of progression of atrophic lesions, and the screening of high risk age-related macular degeneration patients based on early biomarkers using our deep learning approach. Our AI-based segmentation, screening, and prediction algorithms have great potential to be translated to applications in clinical research and clinical practice in ophthalmology and generate important impact.

Ziyuan Wang, SriniVas R. Sadda, Zhihong Hu, "Deep learning for automated screening and semantic segmentation of age-related and juvenile atrophic macular degeneration," Proc. SPIE 10950, Medical Imaging 2019: Computer-Aided Diagnosis, 109501Q (13 March 2019);

https://scholar.google.com/citations?hl=en&user=L4XrrDAAAAAJ&view_op=list_works

Disease(s): Age-related macular degeneration (AMD), Juvenile macular degeneration (JMD)

NeuroDotVR

Contact: Srinivas Sridhar, https://www.northeastern.edu/cri/portfolio_page/neurofieldz-inc/

The NeuroDotVR combines a wireless electric brain sensor with a virtual reality smartphone display enabling custom visual stimulus patterns, providing tests for neuro-visual disorders. Machine learning artificial intelligence algorithms are used extensively to decode the neuro-ophthalmic electrophysiological signals. The system has been field tested in clinics for macular degeneration, glaucoma, amblyopia, and retinopathy. The NeuroDotVR is portable anywhere to clinics and in the field, enabling new diagnostic tests that are completely objective in that it does not require patient response, and can also be used for virtual reality based therapies, expanding current practice for ophthalmologists and optometrists.

Disease(s): Age-related macular degeneration (AMD), Diabetic retinopathy (DR), Eye movements/strabismus, Glaucoma, Low vision, Neuro-Opthalmologic diseases

Orion Device-independent OCT Analysis Software

Contact: Daniel Russakoff, daniel@voxeleron.com

At Voxeleron, our mission is to be a world leader in delivering advanced ophthalmic image analysis solutions.

We are proud to present Orion, our AI-enabled, device-independent OCT analysis software. Orion is your one-stop-shop for your lab or clinical trial, offering:

- *8 retinal layer segmentation*
- *Intelligent layer editing*
- *Longitudinal analysis*
- *Batch processing*
- *Angiography analysis*
- *ONH analysis*
- *DICOM export*
- *3D visualization*

Disease(s): Age-related macular degeneration (AMD), Glaucoma, Retinal disease (other than DR)

Pegasus

Contact: Sameer Trikha MBA FRCOphth, strikha@doctors.org.uk

Mr. Sameer Trikha is an Ophthalmic surgeon and CMO of Visulytix, a London-based artificial intelligence company. Mr Trikha discusses the world's need for an effective way to make up for the deficit of ophthalmic specialists. He discusses how recent technological advances are enabling development of artificially intelligent systems which match the effectiveness of human specialists and ease the burden on primary care. He also describes the impact these technologies can make in areas with restricted resources, as well as the inevitability of intelligent clinical decision support systems in healthcare worldwide.

Disease(s): Age-related macular degeneration (AMD), Diabetic retinopathy (DR), Glaucoma, Retinal disease (other than DR)

Trainable WEKA segmentation on IMAGE-J

Contact: Isaac Gendelman MS4 Tufts University School of Medicine, Isaac.Gendelman@tufts.edu

In this video the WEKA machine learning plugin for ImageJ is described in its application for ophthalmic imaging research. This tool is an accessible and flexible tool for exploring machine learning without needing to code or have a specialized computing environment. We will explore the tool's capability and demonstrate examples using ophthalmic images taken with OCT Angiography.

Disease(s): Age-related macular degeneration (AMD), Diabetic retinopathy (DR), Retinal disease (other than DR), Variety of pathology and anatomy

Zilia Ocular

Contact: Dr. Patrick Sauvageau, OD, MSc, CEO & Co-Founder, info@ziliahealth.com

Zilia has developed an innovative, non-invasive platform technology that uses imaging, spectrometry and artificial intelligence to measure, quantitatively and in real-time, different biomarkers in the human eye, starting *with oxygen – a crucial factor in diseases of the eye such as glaucoma, diabetic retinopathy and age-related macular degeneration. Zilia's first product, a revolutionary ocular oximeter named Zilia Ocular, combines hardware and software components to help eye care professionals prevent, diagnose and manage these ocular diseases. In this short video, Zilia will show how it uses the power of AI in its quest to help save the sight and improve the health of millions.*

Disease(s): Age-related macular degeneration (AMD), Diabetic retinopathy (DR), Glaucoma