Summer Research Opportunities by Mentor - 2025

Jan P G Bergmanson, OD, PhD, D.Sc. - Texas Eye Research and Technology Center offers a number of interesting opportunities. We are studying scleral gas permeable contact lens wearers, post-refractive surgery patients and patients with anterior segment pathologies. In addition, we are conducting research in ocular anatomy and pathology at a cellular and subcellular level using light and electron microscopy. In these studies, the research is utilizing human cadaver eyes and corneal buttons from keratoplasty transplant surgery. These specimens will allow the study of normal anatomy, diseases like keratoconus, macular-, granular-, lattice- and Fuchs endothelial-dystrophies, some of which are rare anomalies. You could be part of this team effort.

Han Cheng, OD, PhD - My general research interest lies in enhancing the diagnosis and management of ocular and visual conditions. I am currently working on two research projects: the first explores the application of artificial intelligence (AI) tools in primary eye care, while the second continues our investigation into SpotChecks, a new contrast sensitivity test, in patients with ocular diseases.

Vivien Coulson-Thomas, PhD - The main interest of my lab involves the extracellular matrix (ECM) and how it regulates development, homeostasis, aging and pathological processes of the ocular surface with the goal of developing new therapies. Current projects available include (1) establishing how the limbal stem cell niche maintains viable limbal stem cells, (2) investigating how the ECM regulates corneal regeneration, inflammation and pathological angiogenesis, (3) establishing the etiology of Meibomian gland dysfunction (MGD) and developing prevention strategies, and (4) identifying factors that contribute to lacrimal gland inflammation and dry eye disease. A student working on either of these projects would attain hands-on experience in a vast array of cell biology techniques including primary and established cell line culture, histology, immunofluorescence, protein purification, Western Blotting, molecular biology, imaging, image analysis, and high pressure liquid chromatography. Our lab utilizes various transgenic mouse models and human tissues.

Luca Della Santina, PharmD, PhD - My laboratory focuses in identifying the alterations occurring to retinal function and synaptic connectivity during ocular diseases. Projects include: 1) Imaging and quantification of synaptic rearrangement occurring in the retina following to neuronal loss using confocal microscopy 2) Development of high-performance image analysis algorithm for quantification of large number of synapses 3) Development of deep learning neural networks for automating the detection of external ocular diseases from photographs and video streams.

Tarsis Gesteira Ferreira, MSc., PhD - Our laboratory specializes in drug development, with a focus on designing proteins and small molecules to aid in wound healing and regeneration, particularly targeting the ocular surface and dry eye disease. We actively manipulate extracellular matrix (ECM) proteins to explore their roles in development, homeostasis, aging, and various pathological conditions affecting the ocular surface. Our current projects include (1) Engineering small leucine-rich proteoglycans to understand their function in organizing the corneal extracellular matrix and enhancing their affinity to key molecules like TGF- b1, VEGFRII, integrins, and TGFBRII; (2) Developing hyperstable mini-protein binders that target multiple

factors involved in inflammation and corneal wound healing, and (3) Designing small molecules and peptides aimed at developing effective treatments for burns, dry eye, and corneal injuries. Students engaged in these projects will gain extensive hands-on experience in a variety of cell biology techniques, including protein design, protein expression and purification, biophysical analysis of proteins, and Western Blotting.

Wendy Harrison, OD, PhD - The goal of our research lab is to better understand what happens in the eye in patients with diabetes. Diabetes is the leading cause of preventable vision loss in working aged Americans. It affects both blood vessels and nerves in the retina. We evaluate local retinal nerve function with a multifocal electroretinogram and nerve and vascular structural changes with an OCT and retinal photographs. Right now one of our goals is to evaluate how these changes match up with local color vision changes in collaboration with other labs.

Ruth Manny, OD, PhD & Maureen Plaumann, OD, PhD - Our combined research interests include the development of normal and abnormal vision in infants and preschoolers. Assessing visual acuity in these populations can be tricky given their difficulty communicating what they perceive and unfamiliarity with the alphabet. There are alternative tests for assessing visual ability in this age group and our research this summer aims to explore different methods for completing this task. Research in this field would include testing the target age group (children 3 months to 5 years) as well as refining the techniques with adult participants.

Anna Matynia, PhD - The main focus of my lab is to define the neural underpinnings of behavior, specifically pain-related behaviors in mouse models of human disease or injury. We will be investigating light aversion as a surrogate for photophobia and facial grimace for ocular pain in animal models with surgical, pharmacological and molecular interventions. Current projects available are 1) identifying peripheral and central nervous system pathways involved in migraine associate light aversion and 2) defining the complexity of corneal innervation. A student working on these projects will gain experience in behavioral, cell and molecular biological, and/or immunohistological approaches as well as scientific design and analysis.

Lauri Nurminen, PhD - I want to understand how cortical circuits contribute to visual perception in health and disease. To elucidate the relationship between visual cortex and perception, I use electrode arrays to record the activity of cortical neurons and optogenetics to activate or silence cortical neurons in marmosets that perform visual tasks. Currently, my lab is trying to understand how areas of the visual cortex communicate and what roles neural inhibition plays in this process.

John O'Brien, PhD - A major goal of research in my lab is to understand the molecular mechanisms used by retinal neurons to optimize synaptic strength and retinal circuitry to function under different lighting conditions. We will be investigating signal transduction pathways that control the function of gap junction proteins, which form electrical synapses. These studies may involve cell culture or animal (mouse and zebrafish) model systems, molecular biology techniques, and advanced imaging strategies. A second focus of the lab is to understand mechanisms of regeneration and integration of photoreceptors in a zebrafish model of retinal degeneration. We will be studying the differentiation of progenitor cells into rod photoreceptors and the role of microglia in integration of new photoreceptors into the retina.

Lisa Ostrin, OD, PhD - My research interests include environmental and behavioral influences on circadian rhythm, myopia, and the choroid. Light exposure has a close link with numerous aspects of human physiology and has been implicated in several different pathological processes including myopia development, circadian rhythm disturbances, mood disorders, cancer, and metabolic disorders. The intrinsically photosensitive retinal ganglion cells (ipRGCs) are an inner retinal photoreceptor that respond directly to short wavelength blue light, and are responsible for non-image forming functions including circadian rhythm entrainment and pupil size. Ongoing projects in the lab are aimed at investigating the effects of red light on ocular structures, measuring and correlating light exposure with ipRGC activity, circadian rhythm patterns, melatonin, and refractive error, 2) determining the influence of retinal blur on the choroid, and 3) understanding how refractive error and eye length change in young adults.

Nimesh Patel, OD, PhD - The research interest of my lab include the accurate quantification of optic nerve head morphology in normal and disease eyes. We use optical coherence tomography (OCT) to image the eye, and develop custom algorithms for analysis, which are then histologically validated. Current projects in this area include; 1) accounting for retinal curvature for OCT based optic nerve head and macula quantification, and 2) determining the retinal ganglion cell density and axonal characteristics in the peripapillary tissue of healthy and glaucomatous eyes.

Jason Porter, PhD - The main goals of our laboratory are to learn more about the causes of retinal and optic nerve head diseases and how the retina develops in normal eyes. In conjunction with the use of conventional clinical tests (such as fundus photography and optical coherence tomography [OCT]), we use a technology called adaptive optics to correct the blur imposed by the eye's optics and examine the structure of single cells in healthy and diseased eyes. Current projects in the lab include (1) measuring changes in the lamina cribrosa, optic nerve head, and retinal vasculature over time in eyes with glaucoma, 2) examining changes in the photoreceptor mosaic in patients with retinal degenerations (such as retinitis pigmentosa) to better understand genotype-phenotype and structure-function relationships in these diseases, as well as 3) examining how the cone photoreceptor mosaic, foveal pit and optic nerve head change during normal development and differ between healthy eyes with different refractive errors. Occasionally, the lab also has projects that examine retinal structure and function in patients following a concussion and/or traumatic brain injury.

Rachel Redfern, OD, PhD - My laboratory is investigating ocular surface inflammation and infection. We hypothesize ocular surface damage stimulates the release of alarmins which activate toll-like receptors (TLR) to perpetuate inflammation through the production of cytokines and conversely protect the ocular surface through the production of antimicrobial peptides. These studies have been investigating using a variety of models including cell culture, animal, and human subjects to examine molecular changes that occur with disease (e.g. dry eye). Currently, we are examining novel therapeutic options that may modulate the risk of inflammation and infection.
Given the prevalence of dry eye expected to double over the next few decades and the lack of definitive treatment regimes, there is a critical need to development of therapeutic regimens that reduce inflammation while not increasing the risk for infection.

Christophe P. Ribelayga, PhD - A major research focus in our lab is to elucidate how the retina processes information and adapts to an environment constantly changing over the course of the

day/night cycle. We are particularly interested in understanding the role of gap junctions (or electrical synapses) and that of endogenous circadian (24-hour) clocks in the daily plasticity of retinal circuitry. Our overall goal is to identify the ways through which retinal clocks generate output rhythms in physiology and behavior. We have developed/used a variety of mouse models for that purpose. A student joining our lab would gain hands-on experience in electrophysiological and histological analysis of the retina, and/or analysis of mouse visual behavior.

Eric Ritchey, OD, PhD - The research interests of the Ritchey Lab are in the areas of contact lenses, myopia, and dry eye disease. My research examines factors related to contact lens comfort and dropout, with a goal of predicting which contact lens product matches the need of the patient. This includes subjecting and objective methods for evaluation of Lid Wiper Epitheliopathy and Meibomian Gland Disease. In myopia, my research interest is in contact lens control of myopia progression and the visual performance of these contact lenses. I am interested in the optical profiles of contact lenses, the effect on treatment efficacy, and the quality of life with these devices. In dry eye disease, the lab is investigating how low-level light therapy affects patients with dry eye, including the effect of this therapy on meibum secretions.

Kaitlyn Sapoznik, OD, PhD - We use high-resolution retinal imaging systems, like adaptive optics scanning laser ophthalmoscopy (AOSLO) and optical coherence tomography (OCT), to study retina microvascular remodeling and blood flow in disease and aging. Adaptive optics (AO) corrections ocular aberrations allowing us to see individual cells (like red blood cells and cones) in the living human retina. Using this type of imaging allows us to assess changes before we can detect changes in the clinic. Currently, we are assessing these vascular changes in diabetes, hypertension, glaucoma, and normal aging. We are also looking for a student to work with on using OCT to assess optic nerve morphology in patients with optic nerve pathology.

Diane Sayah, OD, PhD - Our current research focuses on the biomechanical properties of the sclera in glaucoma and myopia. In other words, we use an imaging technique to measure if a subject's eyeball is rigid (like a soccer ball) or compliant (like a birthday balloon), and evaluate the role of this parameter in the development and progression of eye diseases. Current projects include investigating the role of ocular rigidity in the development and progression of childhood myopia. Students with a keen interest in ocular imaging, image processing, and/or clinical research are encouraged to discuss their specific interests with Dr. Sayah, as other projects may be in the pipeline.

Maria Walker, OD, PhD - My research interests are based around ocular surface research in disease and contact lens wear. I have a translational research lab, which means that I collect clinical data and samples and often use basic science techniques to assess these samples in the lab. I mostly focus on collection of tear samples, evaluating the proteins, cells, and lipids contained to understand inflammation and how it plays a role in disease and lens wear. The primary disease we are focused on is keratoconus, and our research is often in keratoconus and other disease populations that are wearing scleral lenses. My scleral lens research interests range from evaluating the tear fluid for inflammatory cells and analytes, to investigating the impact of scleral lenses on corneal structure and metabolism.

Geunyoung Yoon, PhD - My lab's research interests cover broad areas in physiological optics, vision science, and biomedical engineering. The overarching goal of my laboratory is to improve our understanding of optics of the eye, its impact on neural processing and spatial vision, and underlying mechanisms of eye problems such as keratoconus, presbyopia, and refractive error development/control. We achieve this goal by conducting human-based translational research that involves advanced optical imaging modalities, vision correction technology (adaptive optics and wavefront-guided contact lenses), and visual psychophysics paradigms.