The field of computational imaging and displays is advancing rapidly. Recent developments in light field displays and optimization approaches to classic image processing have the potential to fundamentally change fields ranging from virtual and augmented reality to vision-driven autonomous agents. Having witnessed the academic process at Stanford firsthand through research in imaging and display groups, I strongly believe that a Ph.D. in electrical engineering from this university would equip me with the tools necessary to contribute to this highly promising field.

I am currently in my second year of the M.S. program in computer science here at Stanford, where I hold a GPA of 4.0. I previously completed a B.Sc. in electrical engineering at the Technical University of Munich (TUM), where I ranked in the top 3% of students. In parallel, I completed the interdisciplinary Technology Management honors program, which was founded as a joint initiative of MIT and TUM and is acclaimed as one of the most prolific sources of ventures in southern Germany.

My interest in image processing was first sparked through robotics coursework during an exchange at the Hong Kong University of Science and Technology. I focused my undergraduate studies on this field, graduating with a thesis on leveraging a monocular Simultaneous Localization and Mapping (SLAM) algorithm for augmented reality. In my literature review, I read published work by Stanford's computer vision groups on topics such as scene geometry inference from images and object classification in RGB-D images. I decided to apply to Stanford to work on research in image processing. I made this choice even though it meant leaving a startup that I had co-founded and that had just received substantial financing, since I felt the need to contribute to work on projects with a more profound, long-term impact. I was fortunate to be awarded one of 75 German Fulbright fellowships, a fellowship of the German National Academic Foundation, as well as a full tuition scholarship from Stanford University to finance my academic endeavors.

Here at Stanford, I followed my interest in computer vision and worked on a project in Prof. Fei-Fei Li's computer vision laboratory. I developed and trained a neural network architecture to detect specific action categories in video. Here, I acquired a strong background in developing machine learning pipelines for image processing, as well as an understanding for the underlying, highly non-convex optimization problems. At the same time, I worked as a research assistant in Prof. Wandell's Vision Imaging and Science Technology laboratory. I contributed to Prof. Wandell's Scientific Transparency project by developing software to enhance data sharing and reproducibility in brain imaging research. Academic research projects in this lab first sparked my interest in the field of computational imaging. I was fascinated by the intricacies of the imaging pipeline and the challenges that it has to solve. I learned that formal optimization techniques and machine learning have recently led to new approaches to problems such as demosaicing, denoising, and color balancing. Similarly, in the field of display development, the emergence of virtual and augmented reality and the resulting new technologies such as light field displays have led to a need for novel signal processing approaches. I decided to delve deeper into this field that I believe will have a great impact on both consumer technology and through the development of new sensors, research in robotics and autonomous agents.

This insight motivated me to join Prof. Wetzstein's Computational Imaging Group. I led a project investigating how users explore virtual reality (VR) scenes. We designed and implemented an experimental setup that allows us to record head and gaze trajectories of users in VR. We brought our setup to SIGGRAPH, one of the largest computer graphics conferences, where we recorded 138

people, comprising 780 gaze and head trajectories in 22 VR scenes. We have since analyzed this dataset to generate insights into human perception and behavior in VR. This is the first step towards creating a rich resource for the development of cutting-edge display concepts such as foveated rendering or gaze contingent focus tuning, but also for developing smarter compression algorithms for high-bandwidth VR content. Specifically, this dataset is the first of its kind large enough to allow for data-driven approaches to these challenges. We have submitted our work to the Conference on Computer Vision and Pattern Recognition [Sitzmann 2017] and will make the whole dataset available to the public. This project was instrumental in receiving a research grant from Google to finance further research into the development of novel VR display concepts.

These projects have convinced me that there is no better place to contribute to research than Stanford. Recent work at Prof. Wetzstein's and Prof. Girod's groups in imaging, displays and image processing is a perfect fit for my research interest. I have identified several projects that match my interest with students from these groups, such as the task-specific joint optimization of whole imaging pipelines or the development of new compression algorithms for VR content. Furthermore, I believe that many of the problems we are facing in the field of imaging and displays can only be solved by a joint effort across fields. This is supported by the recent rise of computer vision in the field of computational imaging and the perception-related problems we are facing in VR, such as the mismatch of the human vestibular and visual systems causing motion sickness. Stanford has enabled interdisciplinary collaboration that can solve these issues, such as between Prof. Wandell's group in psychology and Prof. Wetzstein's group in electrical engineering. Additionally, few universities feature groups in computational imaging, computer vision and human perception/neuroscience that are all as widely acclaimed as is the case for Stanford.

A Ph.D. in electrical engineering at Stanford would thus allow me to contribute to the challenges I am passionate about with unmatched support and prepare me for a career as a researcher in academia or industry. Further, it would allow me to continue the research I have begun and build on my existing relationships to professors and students alike. Courses at Stanford are taught by world-acclaimed experts that have contributed immensely to their fields, and would allow me to learn the tools necessary to investigate new directions in my research. My main research interests being imaging, displays and image processing, I would like to work most closely with Prof. Wetzstein and Prof. Girod, and explore collaborations in the fields of psychology and machine learning with the groups of Prof. Wandell and Prof. Duchi.

References

Sitzmann, Vincent, et al. "Saliency in VR: How do people explore virtual environments?" . In review for CVPR 2017.