A Vision for Horizon 2020
A European Strategic Roadmap for Vision Research and Ophthalmology
Optics of the Eye | Susanna Marcos

State of the Art:
The eye is a fascinating optical instrument and its investigation has received attention for centuries. Understanding the optical formation properties of the eye is critical to understand the first stages of visual processing. Measurement and correction of the ocular optical degradation allows imaging the retina with unprecedented resolution, opening possibilities for unraveling mechanisms and improving diagnostics and intervention of retinal disease. Novel instrumentation for imaging the anterior segment of the eye has allowed high-resolution ocular biometry, and accurate geometrical description of the ocular components. A better understanding of the relationships between the structural and optical properties of the optical components in the eye is paving the way to improved (and even customized) optical corrections of refractive errors, corneal pathologies and cataracts. Also, new techniques applied in the eye, such as adaptive optics, are improving the understanding of the relation-

Research Needs:
1. High resolution, dynamic, quantitative imaging techniques of the anterior segment of the eye
2. Improved objective techniques for refractive error measurement
3. Mechanisms of development of refractive errors
4. Corneal pathologies: diagnostics and treatment
5. Aging of the optics of the eye: presbyopia and cataract
6. Improved corrections for refractive surgery, contact and intraocular lenses and low vision

Impact:
Conditions of the anterior segment of the eye are a public health burden and their treatment has a large economic impact. Around 30% of the population in Europe suffers from refractive errors. Presbyopia affects 100% of the population older than 45 (over 230 million people in Europe and over 50% of the European population in 2030). Corneal pathologies are also frequent, and in many cases the only available treatment to date is corneal transplant from donor eyes. The annual worldwide market of ophthalmic products was over 20 billion euros, and increases by 10% yearly. Lenses and eye care products, diagnostic instruments, cataract surgery and refractive surgery, all directly related with the optics of the eye exceeds 57% of the revenues. Undoubtedly research, development and innovation in oculcar optics products is of tremendous impact towards the increase of quality of vision and quality of life, as well as economic growth.

Future Development:
Future developments include new optical imaging-based diagnostic ophthalmic devices, with increased accuracy and versatility. These instruments will improve clinical practice and surgery, allowing customized treatments. Future developments will also include new generation of corneal and intraocular treatments, aiming at mimicking the optical and biomechanical properties of the cornea and crystalline lens of the healthy young eye.