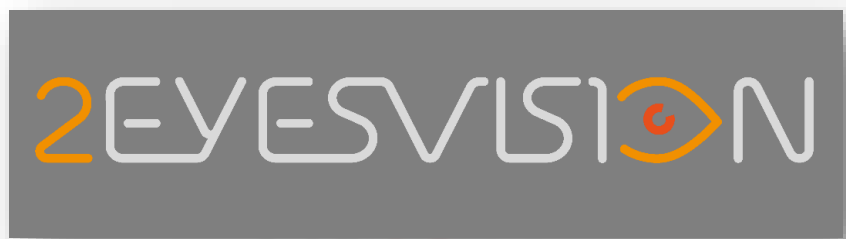
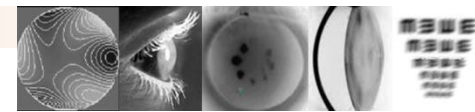
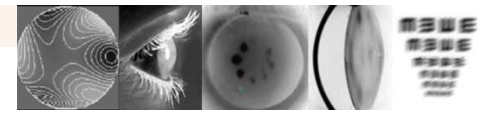


Creación y crecimiento de empresas de base tecnológica en el área de la óptica: cuatro ejemplos

Carlos
Dorronsoro
9 de abril de 2019

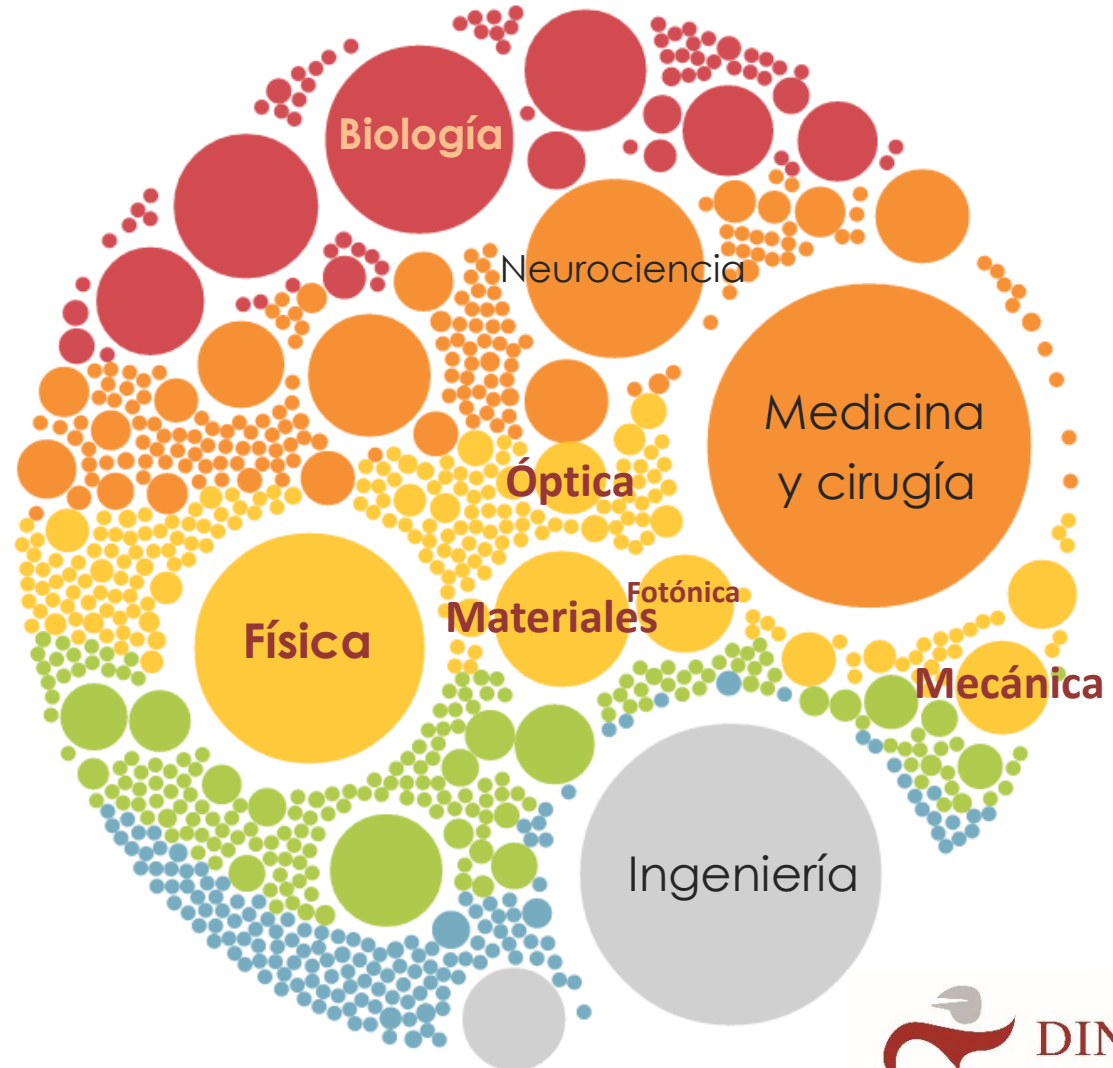






Investigación Multidisciplinar

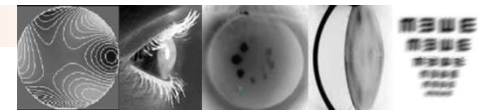
VIObIO
VISUAL OPTICS & BIOPHOTONICS LAB



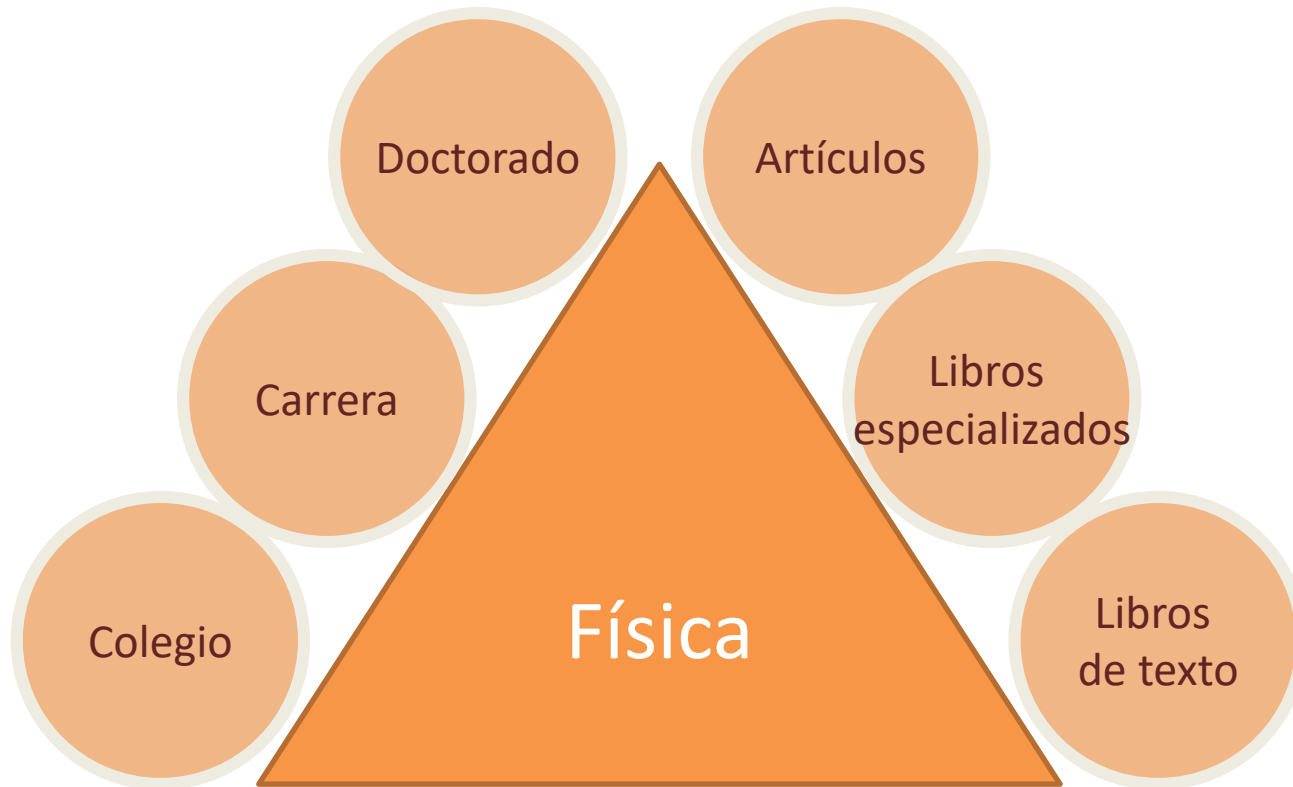
 Instituto
de
Óptica

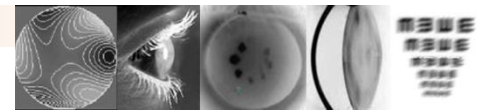
 **CSIC**
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

 **DINAMIZA**
CSIC INNOVACIÓN



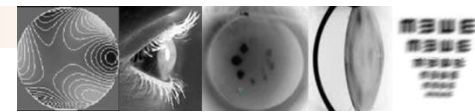
Motivación?





Motivación





VI0BIO Investment proposal in the field of ophthalmology (2013)

Visual Optics and Biophysics Lab Profile of the Research Group

People
 The lab is directed by Dr. Carlos Dorronsoro, who has been working in the field of visual optics and biophysics for over 10 years. He is currently a senior research fellow at the CSIC. The lab also includes several postdoctoral fellows and research assistants.

Activities
 The lab is currently working on several projects, including the development of new optical devices for vision correction, the study of the visual system's response to different types of light, and the development of new diagnostic technologies for eye diseases.

CSIC

Ocular Imaging and Diagnostic Technologies Investment proposal in the field of ophthalmology (2014)

VI0BIO Portfolio of technologies in the field of Vision Correction

Quantitative Anterior Coherence Tomography
 This technology allows for the quantitative measurement of the thickness of the cornea and the lens, providing a more accurate diagnosis of refractive errors.

Purkinje Imaging System
 This system is used to study the structure and function of the Purkinje cells in the retina, which are important for visual processing.

Quantitative Scheimpflug
 This technology provides a detailed 3D map of the cornea, allowing for a more precise measurement of its curvature and thickness.

CSIC

Laser Ray Tracing
 This technology is used to simulate the path of light rays through the eye, helping to predict the effect of different optical corrections.

Adaptive Optics Visual Simulator
 This simulator allows for the study of the visual system's response to different types of optical aberrations, providing valuable insights into the mechanisms of vision.

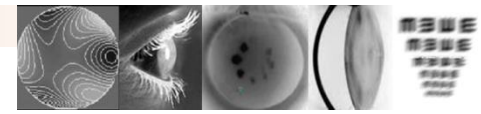
Simultaneous Visual Simulator
 This simulator is used to study the visual system's response to multiple visual stimuli at the same time, which is important for understanding the system's capacity for parallel processing.

Low-cost retinoscometer- Quicksee
 This device provides a quick and accurate measurement of the refractive error of the eye, making it a valuable tool for clinical practice.

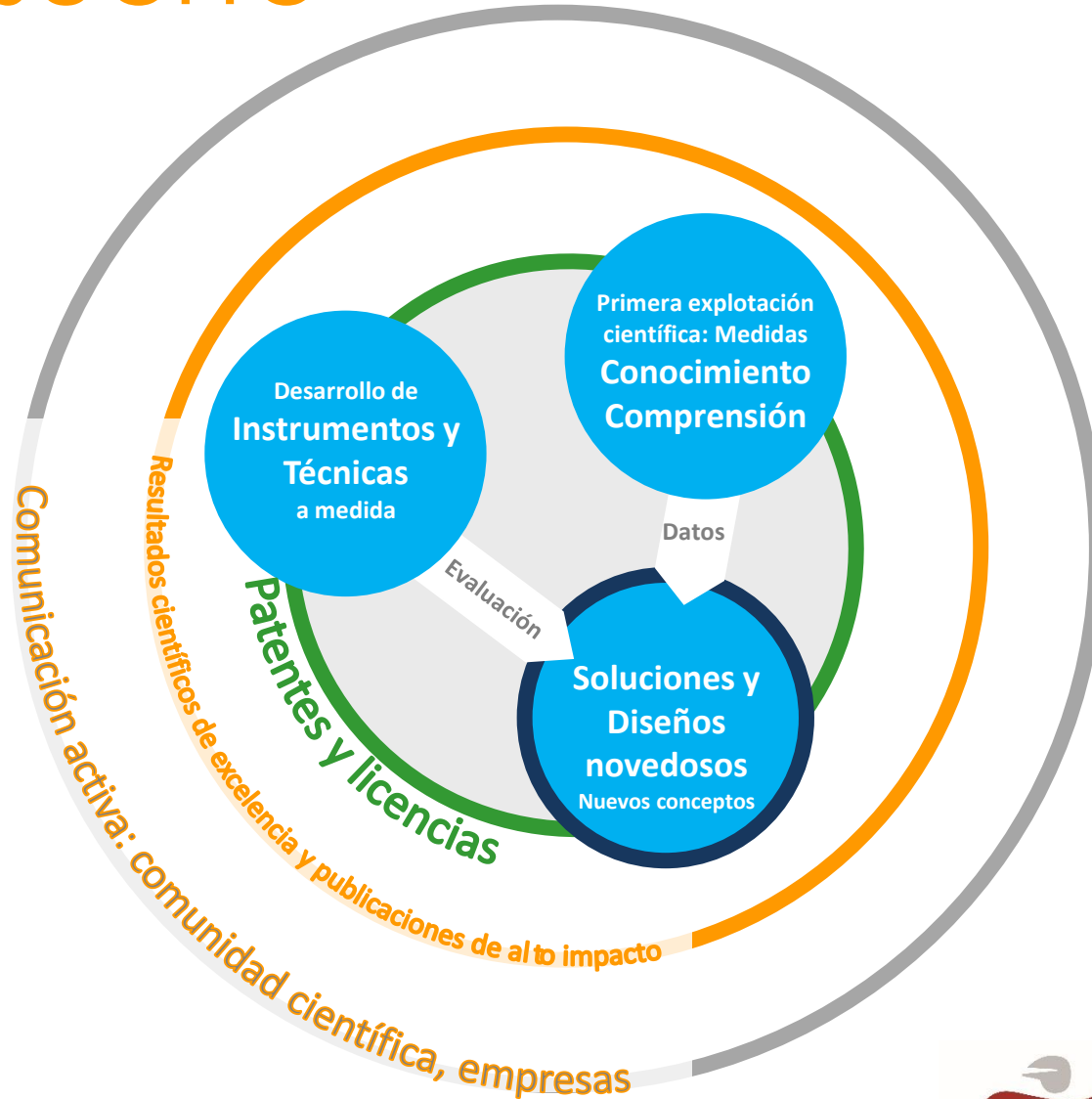
Ocular microscopy imaging
 This technology allows for the high-resolution imaging of the eye's internal structures, providing a detailed view of the retina and other tissues.

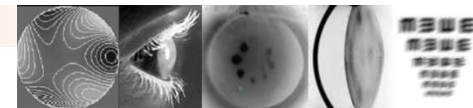
CSIC

from “VioBio Investment Proposal”,
 First Version 2013



Crear "suerte"

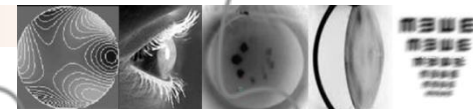




Transferencia Tecnológica: Claves

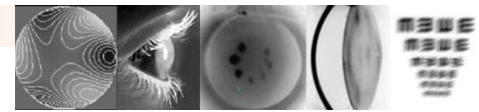
- Orientar la investigación
- Establecer colaboraciones industriales
- Acumular know-how y tecnología única
- Patentar selectivamente
- Licenciar y colaborar

- Excepcionalmente: Spin-off

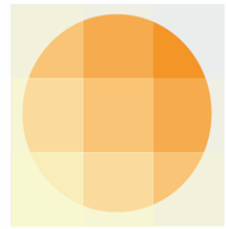


EBTs: un pequeño milagro

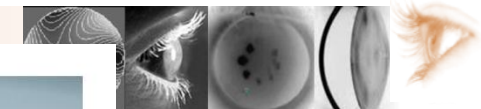
- Tecnología
- Equipo
- Habilidades
- Financiación
- Entorno
 - Competencia
 - Evolución
 - Regulación
 - Aprobaciones
- Viabilidad
 - Técnica
 - Empresarial
 - Personal
 - Legal
 - Propiedad intelectual
 - Compatibilidad
 - Exclusividad



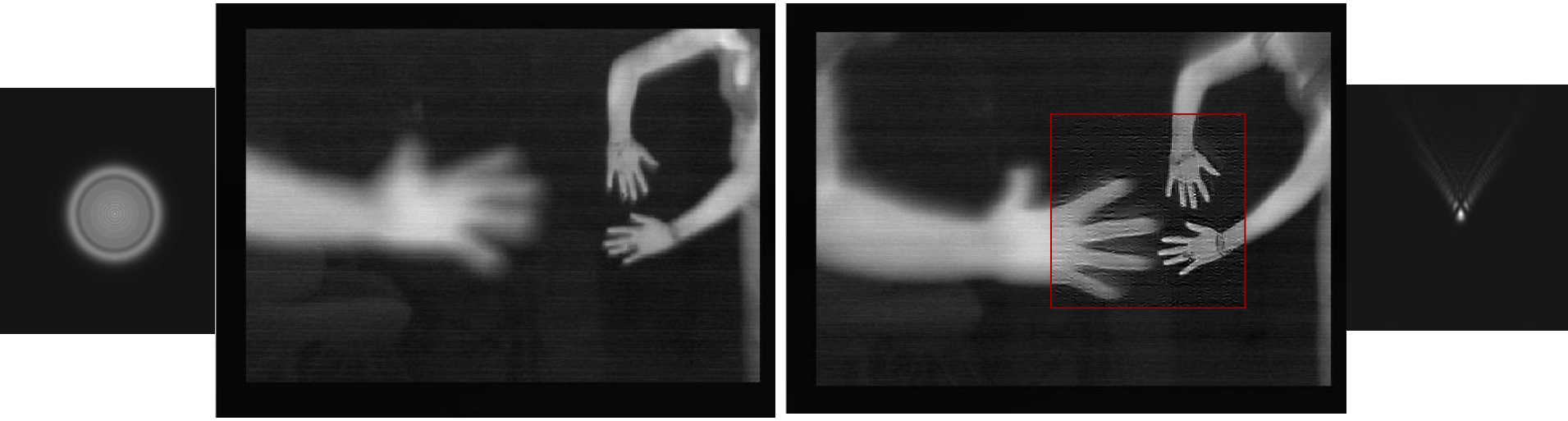
1



Imatrics
IMAGE TECHNOLOGIES



Cámara híbrida óptico - digital

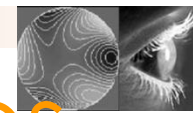


Es posible realizar codificación de frente de onda en el infrarrojo utilizando óptica de muy bajo coste.

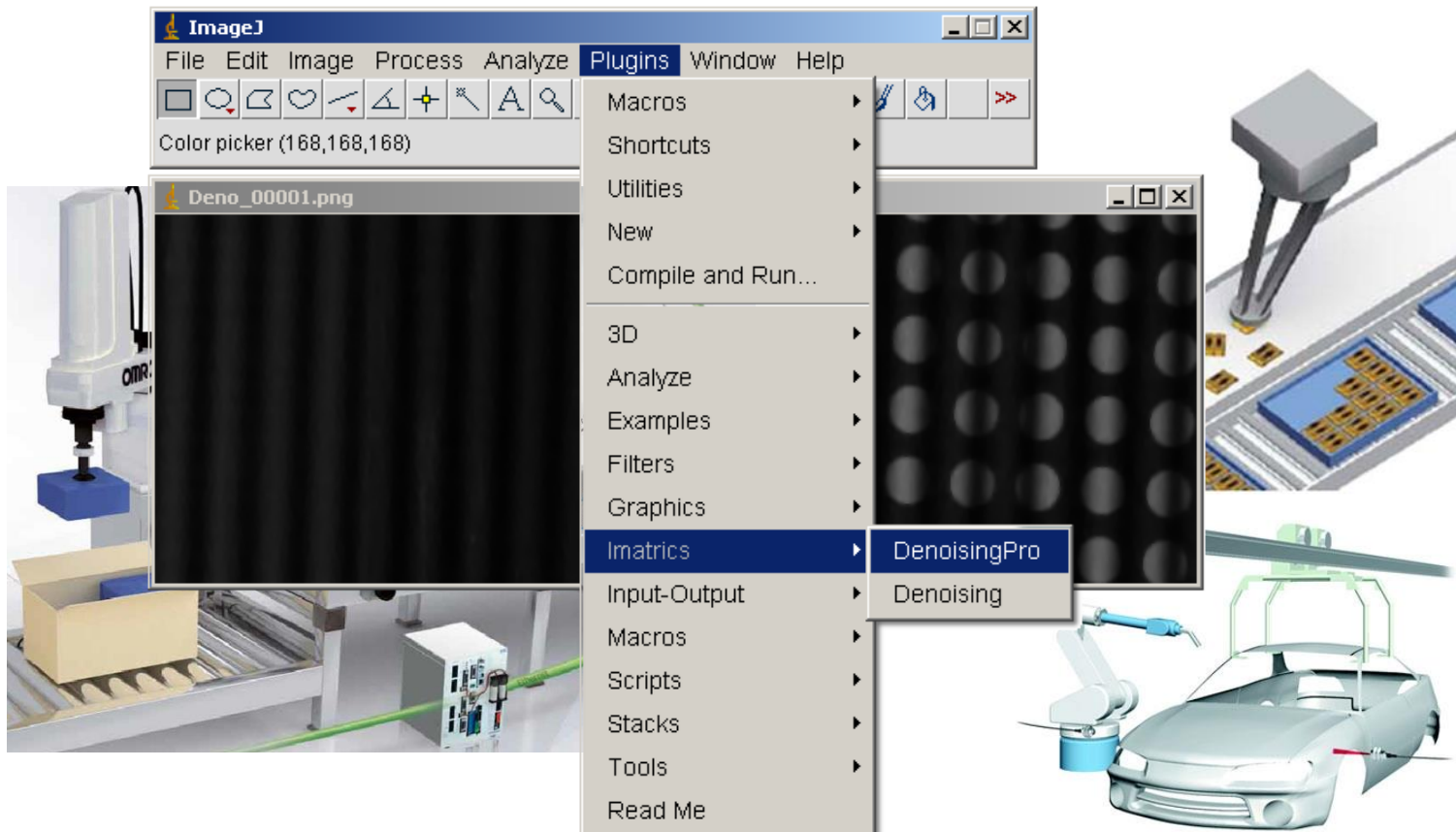
► J. Portilla, J. A. Guerrero, C. **Dorronsoro**
Patente OEPM P200602116. 2006

► **Dorronsoro**, Guerrero-Colon, de la Fuente, Infante, Portilla
Proc. of the SPIE, vol.6737 (2007)

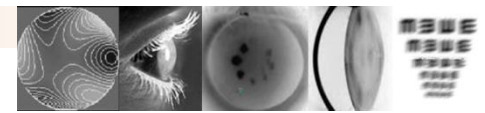




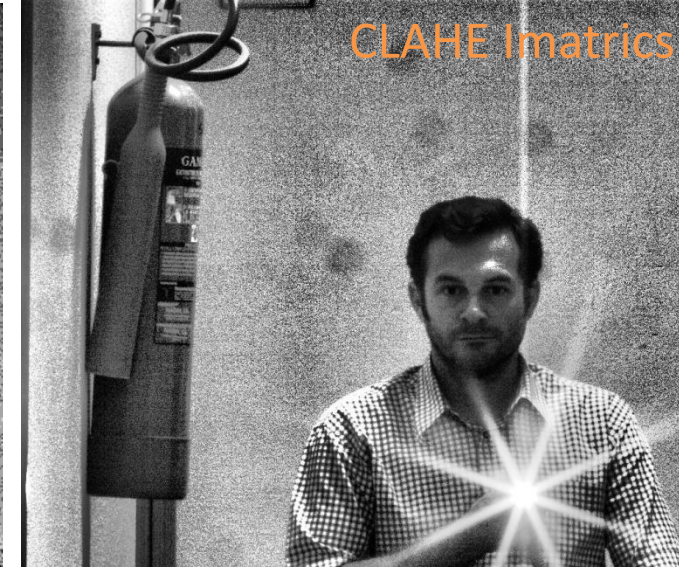
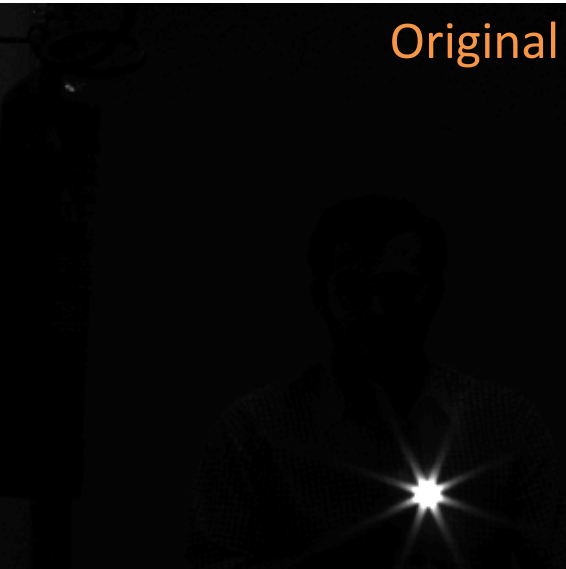
Restauración de imágenes para visión robótica

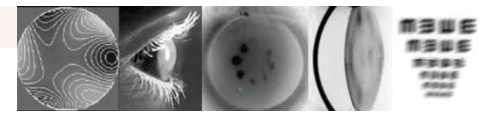


Mejora de la visión robótica 3D en precisión y velocidad con restauración de imágenes avanzada.



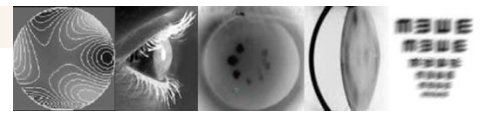
Procesado en tiempo real





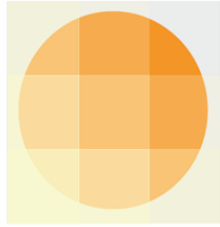
Descuantización



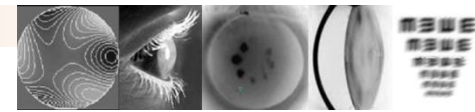


Compensación de vibraciones





Imatrics
IMAGE TECHNOLOGIES

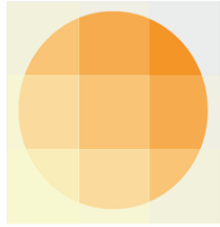


Origen: 2006

- Tesis + Investigación colaborativa: UGR CSIC CIDA
- IP: Patentes previas

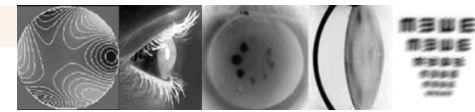
Creación:

- Demanda: contrato de desarrollo de tecnología y proyectos
- Ventana de oportunidad (disponibilidad y compatibilidad)
- Capital social mínimo, repartido entre emprendedores
- Rentable: Facturación inmediata (recuperación de la inversión)
- Acuerdo de Spin-off y Licencia de patentes, pero no fueron explotadas



Imatrics

IMAGE TECHNOLOGIES

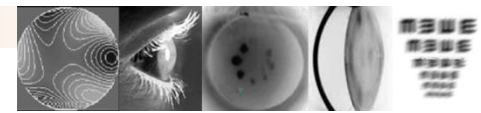


Crecimiento:

- Centro de desarrollo: 2 años de desarrollos tecnológicos propios
- Cambios en el modelo de negocio y en el reparto social
- Ingresos crecientes (contratos de desarrollo con tecnología propia)
- Autofinanciación y reinversión en I+D
- Capital social: Mínimo y estable, repartido entre emprendedores
- Ayudas: Mentores, madri+d, TQ

Fin:

- Cierre de la ventana de oportunidad (disponibilidad y compatibilidad)
- Baja voluntaria en 2014 y reparto de beneficios

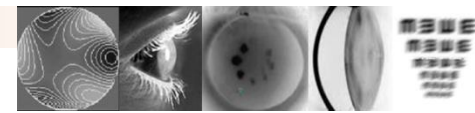


2



IMAGING
IMAGING

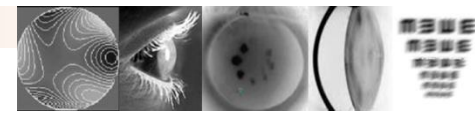
Alfa Imaging, SA



Imágenes de ondas milimétricas



Figure 4.24. NASA double-disc imager showing spherical and plane mirrors



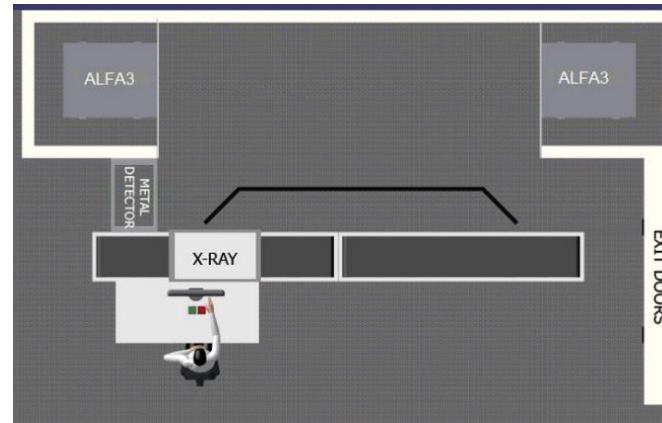
Prototipo de cámara de ondas milimétricas

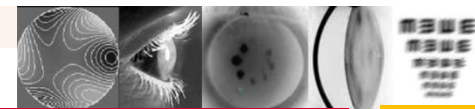
Detección de amenazas:

- Explosivos
- Líquidos
- Metales
- Plásticos
- Cerámica

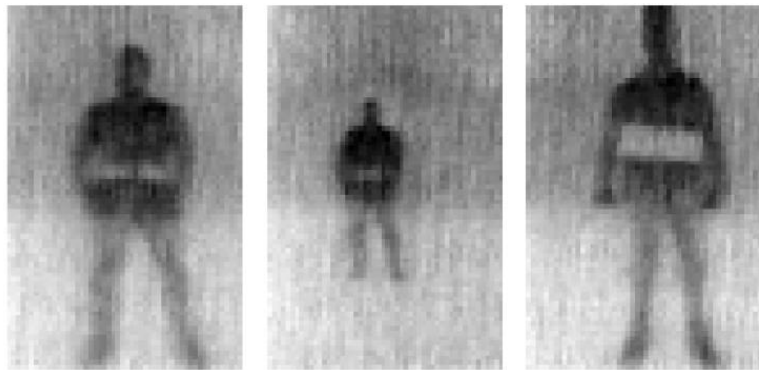


- ## Ventajas:
- Pasivo
 - No invasivo
 - No ionizante
 - A distancia
 - No requiere cooperación





Imágenes MMW: Procesado

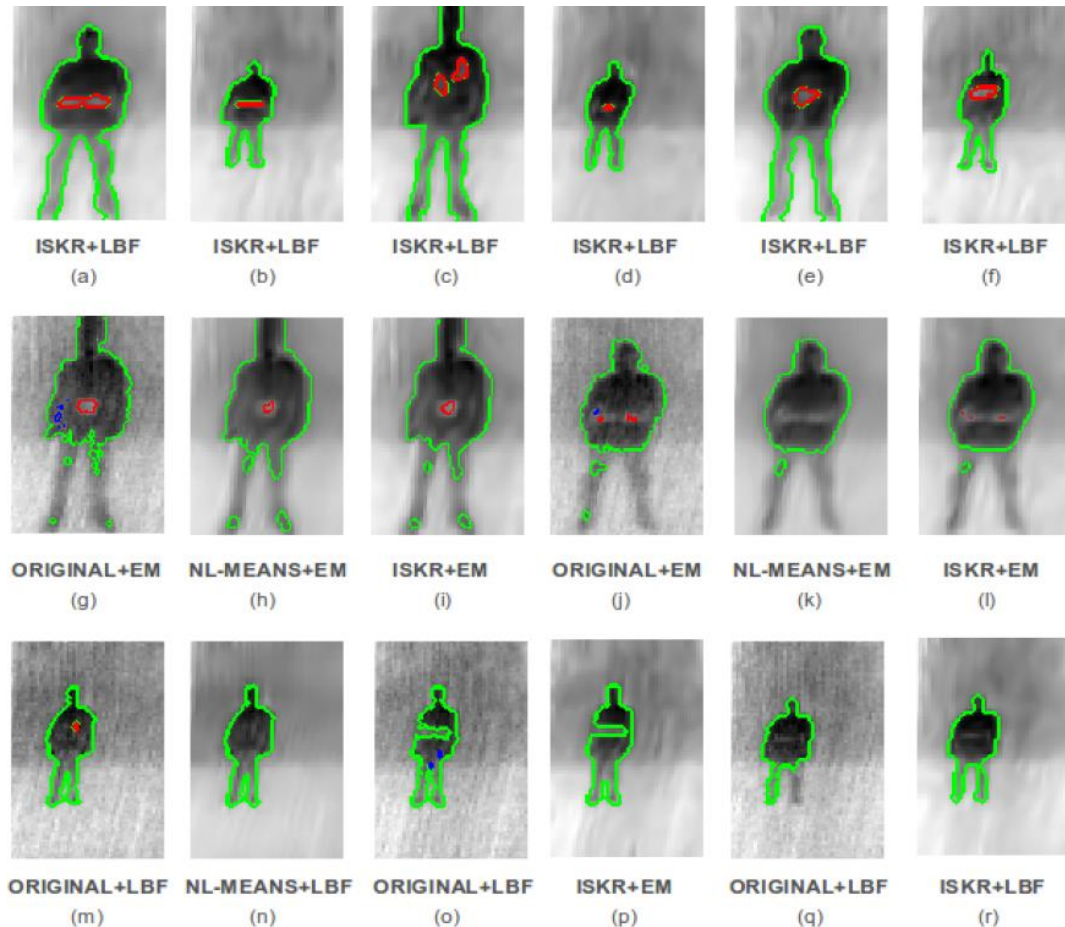


Pólvora

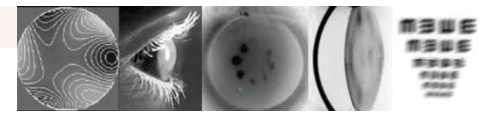
TNT

Cinturón de explosivos

Combinación óptima de métodos de restauración, segmentación de silueta y segmentación de amenaza



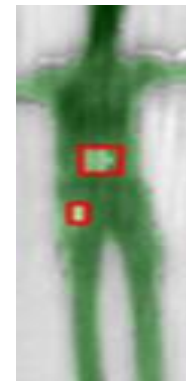
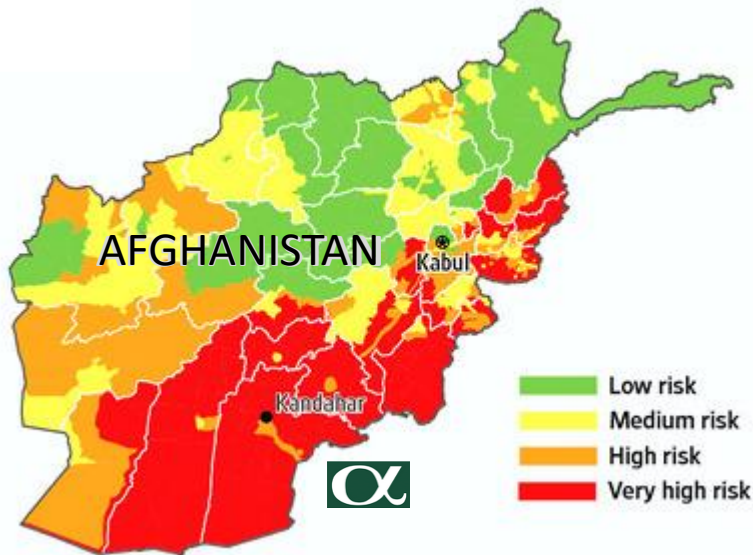
► O. Martínez, L. Ferraz, X. Binefa, I. Gómez and C. Dorronsoro. IEEE Computer Vision and Pattern Recognition. pp.31-37 (2010)

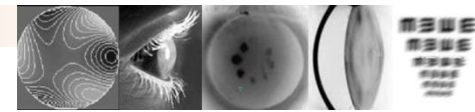


Pruebas reales

Kandahar Air Base, Afghanistan

Hostile Territory | U.N. security-risk assessment



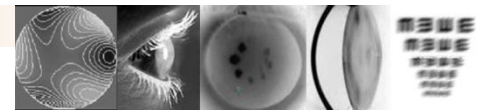


Origen:

- 2 tesis en University of Reading, UK (proyecto NASA) 2004-2006

Creación:

- Cierre de laboratorio
- Negociaciones fallidas con Ministerios españoles
- Migración de laboratorio completo y know how (2 doctores)
- IP: Patentes previa comprada (no explotada) + Patentes Alfa
- Socios: 3 científicos + 2 empresarios + fondo de inversión

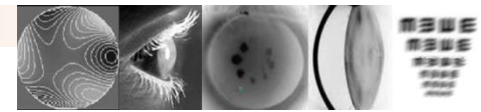


Crecimiento

- Inversión privada: M € (n rondas)
- Capital social: creciente desde 60K€ (SA)-> M €
Emprendedores no diluidos en los primeros años, luego sí
- 8 años de desarrollo tecnológico
Desarrollos propios + colaborativos
- Business plan: Estable
- Subvenciones, proyectos, contratos: OTAN, Ministerios, FP7
- Buen posicionamiento global y demanda

Fin

- Liquidación forzosa en 2015-2017
- Motivo: Vacío regulatorio



3

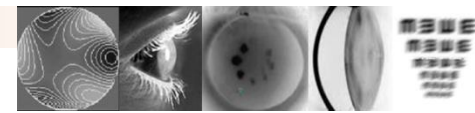
PLEN()PTIKA
— eye care for all —

>2,000,000,000

do not have the computers they need



Figure derived from WHO 2004 report

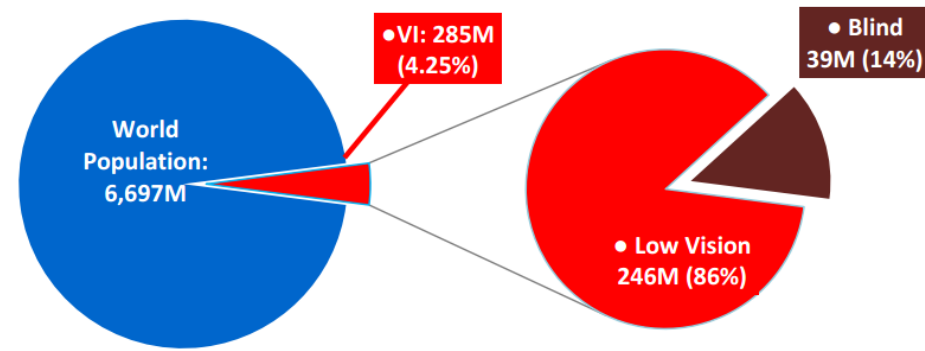


Discapacidad visual en el mundo

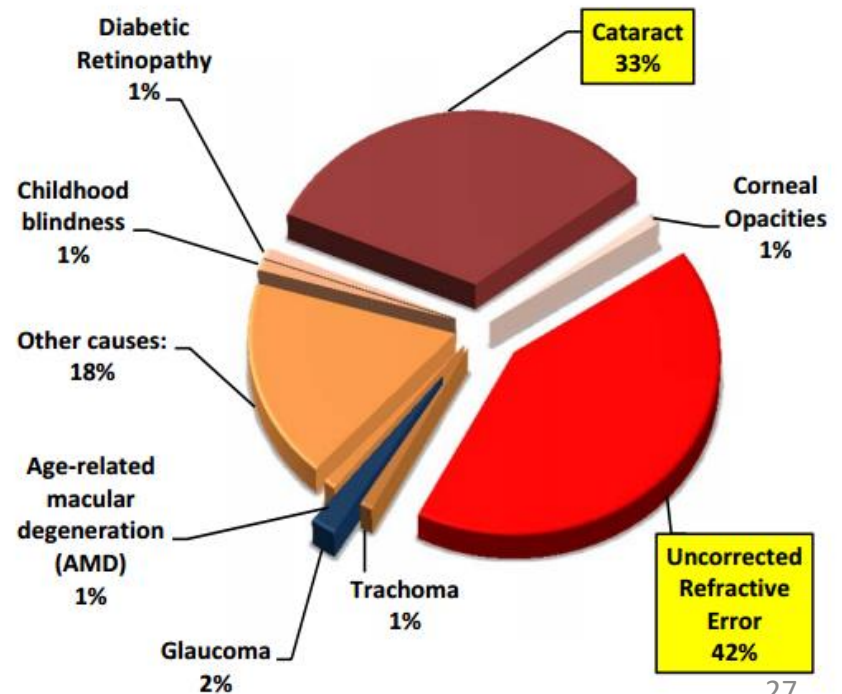
Los errores refractivos no corregidos son la causa principal de discapacidad visual en el mundo, afectando a más de 100 millones de personas.

son la causa principal de **discapacidad visual** en el mundo, afectando a más de 100 millones de personas.

Es **uno de los diez problemas de salud** más importantes del mundo.



Visual Impairment

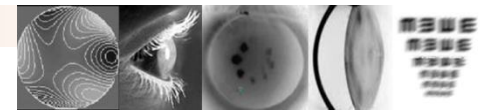


Eyeglasses

\$4

one of the most
cost-effective
healthcare technologies



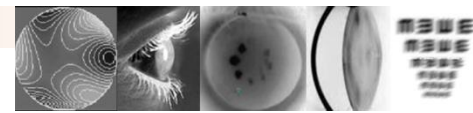


En Occidente, **1 optometrista** cada **6,000 personas**



En India rural, **1 optometrista** cada **250,000 personas**



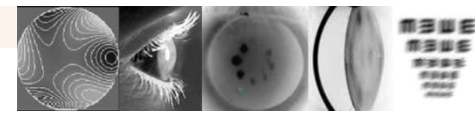


Barreras de la refracción subjetiva

- Necesaria inversión inicial de 500\$



- Necesario tiempo de personal cualificado
 - Formado durante 2 años
 - 15 minutos cada paciente



QuickSee

Refracción
al pulsar un botón



- ▶ US Provisional Patent Application 2013
- ▶ US Provisional Patent Application 2014



(19) **United States**
 (12) **Patent Application Publication** (10) **Pub. No.: US 2016/0128562 A1**
Durr et al. (43) **Pub. Date: May 12, 2016**

(54) **APPARATUS AND METHOD OF DETERMINING AN EYE PRESCRIPTION** Mar. 28, 2014, provisional application No. 61/972,191, filed on Mar. 28, 2014.

(71) Applicants: **MASSACHUSETTS INSTITUTE OF TECHNOLOGY**, Cambridge, MA (US); **CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS**, Madrid (ES)

(72) Inventors: **Nicholas James Durr**, Somerville, MA (US); **Eduardo Lage Negro**, Madrid (ES); **Shivang R. Dave**, Boston, MA (US); **Carlos Dorronsoro Diaz**, Madrid (ES); **Susana Marcos Celestino**, Madrid (ES); **Daryl Lim**, Boston, MA (US)

(21) Appl. No.: **14/900,691**
 (22) PCT Filed: **Jul. 2, 2014**
 (86) PCT No.: **PCT/US2014/045261**
 § 371 (c)(1),
 (2) Date: **Dec. 22, 2015**

Related U.S. Application Data

(60) Provisional application No. 61/842,190, filed on Jul. 2, 2013, provisional application No. 61/972,058, filed on

Publication Classification

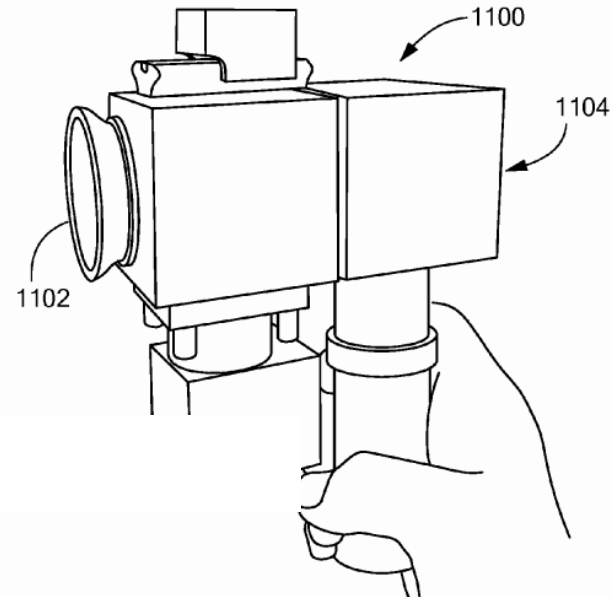
(51) **Int. Cl.**
A61B 3/103 (2006.01)
A61B 5/00 (2006.01)
A61B 3/18 (2006.01)
A61B 3/00 (2006.01)
A61B 3/10 (2006.01)
 (52) **U.S. Cl.**
 CPC **A61B 3/103** (2013.01); **A61B 3/0091** (2013.01); **A61B 3/1015** (2013.01); **A61B 3/0025** (2013.01); **A61B 3/18** (2013.01); **A61B 3/0041** (2013.01); **A61B 5/7415** (2013.01); **A61B 5/7455** (2013.01); **A61B 2560/0425** (2013.01)

(57) **ABSTRACT**

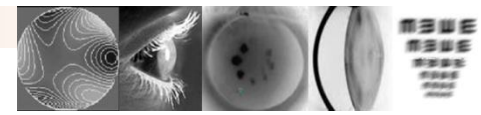
Eye prescriptions may be determined by providing a simple, easy to use, portable device with a specially configured targeting light source that aligns the eye, mitigates accommodation, and provides accurate results. Unlike stationary, closed view autorefractors, this device typically is portable, self-usable, relatively inexpensive, enabling more widespread use across the world.



Innovation, Leadership, Impact

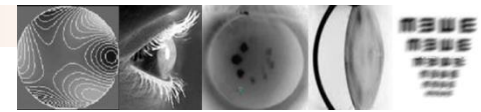


- ▶ US Provisional Patent Application 2013
- ▶ US Provisional Patent Application 2014



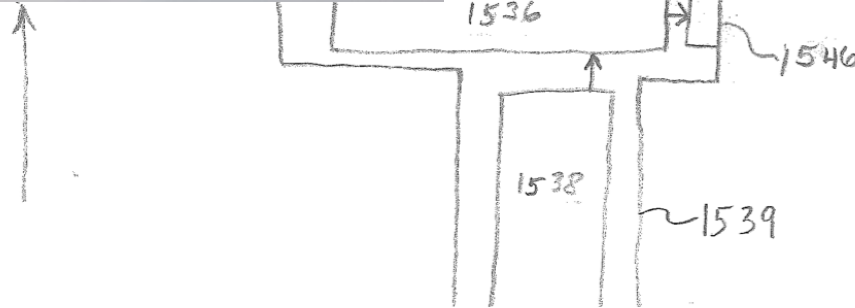
QuickSee





QuickSee

Refracción al pulsar un botón



- ▶ US Provisional Patent Application 2013
- ▶ US Provisional Patent Application 2014

QuickSee enables accurate autorefractivection anywhere



Customer validation

3,000 patients, 7 countries
hospitals, non-profits, optical retailers



Photos courtesy of Aurolab, PlenOptika



about

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admissions

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OpenCourseWare | MITx | edX

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labs+centers | lincoln lab | libraries

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arts | athletics | social media

impact

energy | cancer | diversity | global
industry | public service | Solve

**The MIT Campaign
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Today's Spotlight

Global vision

Portable device can generate corrective lens prescriptions in areas with no optometry care



news

New drug capsule may allow weekly HIV treatment

Sally Miller aims to make safe, clean surgery possible anywhere

John Van Reenen explains why innovations need great organizations

Ultrafine fibers developed at MIT have exceptional strength

[research](#) | [campus](#) | [press](#)

events

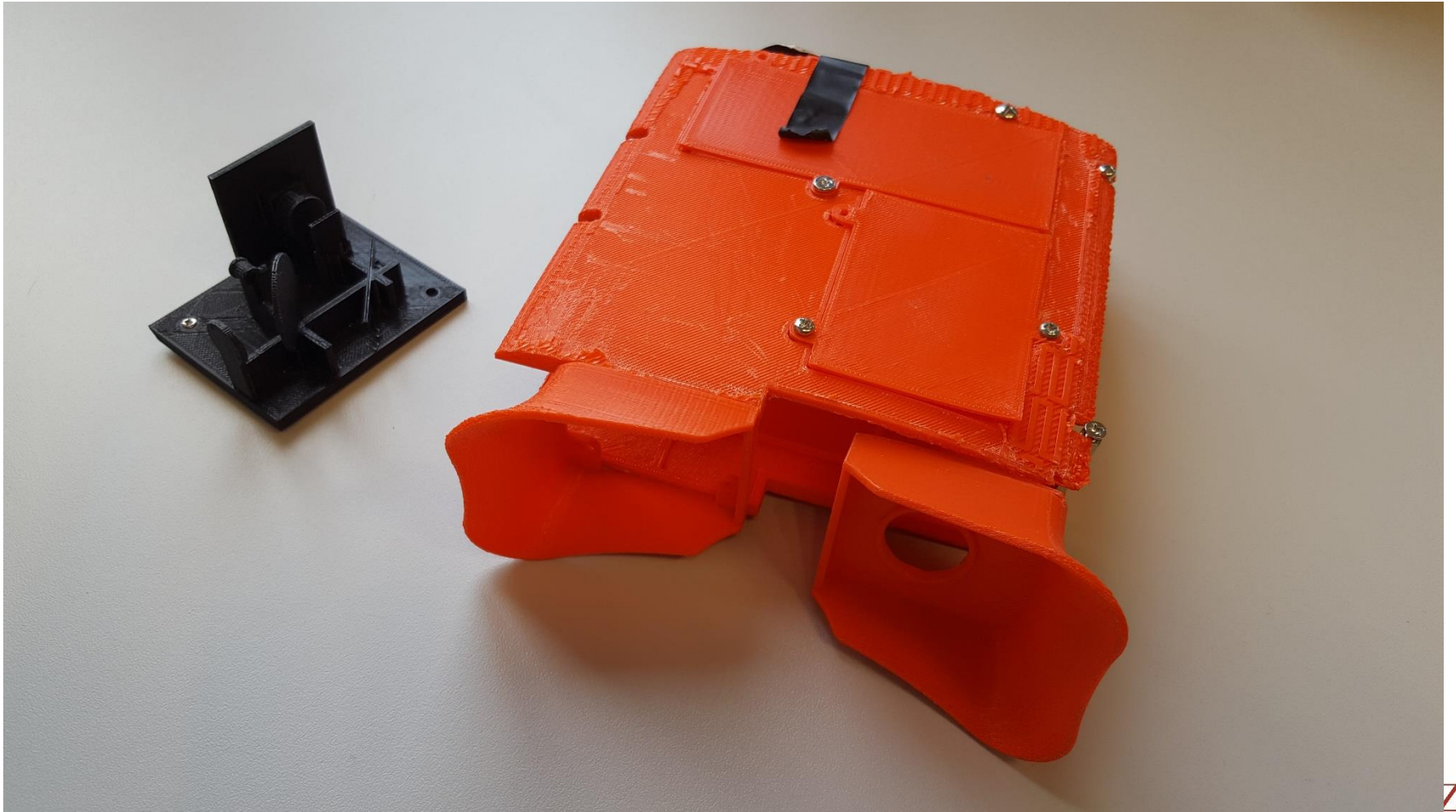
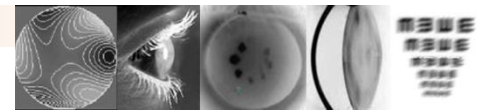
Inspired by Antiquity: The Future of Durable, Sustainable Infrastructure (Jan. 18)

Festival of Learning (Jan. 29)

MIT on Chaos and Climate: A Centenary Celebration of Jule Charney & Ed Lorenz (Feb. 1)

Superheroes Ball (Feb. 3)







Innovation, Leadership, Impact

Achievements

Prizes



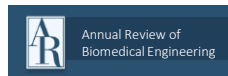
Press



Funding

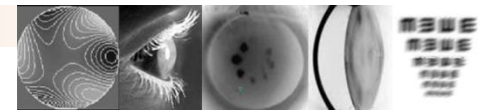


Publications



Alliances





PLENOPTIKA

— eye care for all —

Origen

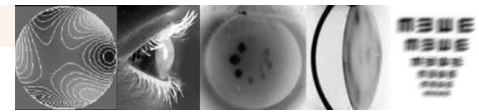
- Programa M+Vision: Madri+d MIT CSIC 2012-2014
- VioBio lab acoge al Eye Team (4 fellows). Retos WHO
- Formación y desarrollo de tecnología.

Creación

- Continuidad al programa
- Socios: 4 doctores + Team (stock options)
- Capital social mínimo
- Patentes CSIC MIT. Licenciadas y explotadas.

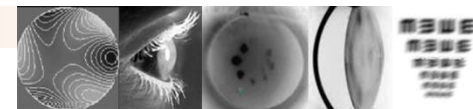
Crecimiento

- Evolución técnica: Desarrollos propios. Patentes. Prototipos
- Financiación: Ayuda, subvenciones, alianzas
- Business plan: Estable con variaciones
- Iniciando ventas

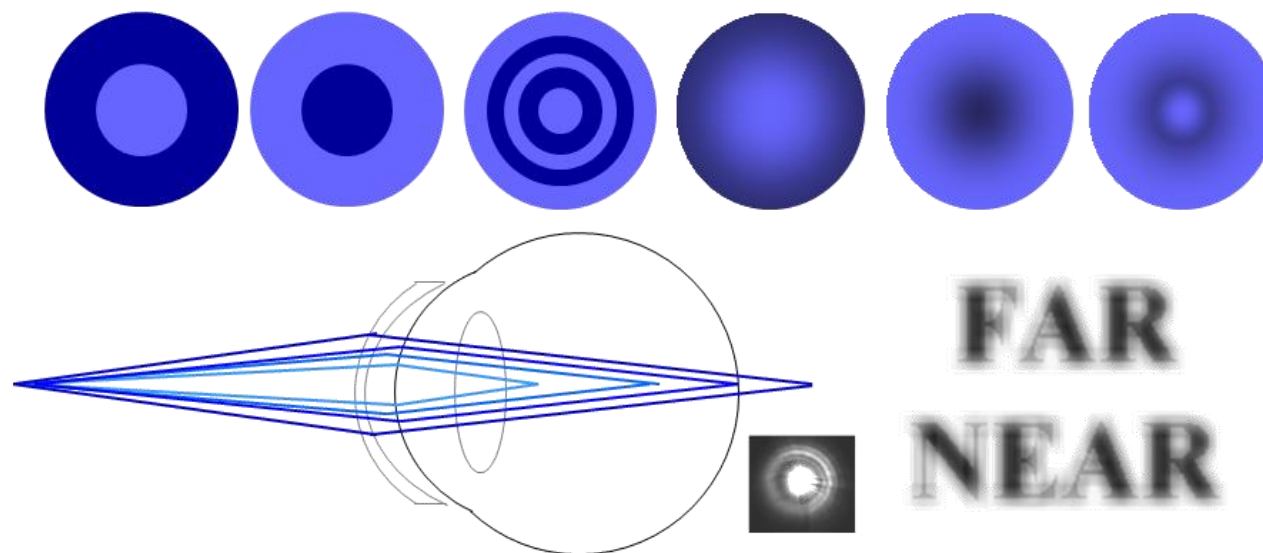


● 4



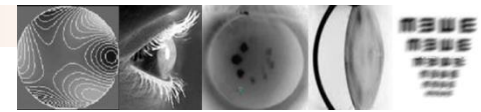


Visión Simultánea



Problema:

- **Algunos pacientes no toleran la visión simultánea**
 - En **lentes de contacto**: prueba y error, ineficiente y caro
 - En **cirugía** refractiva y de cataratas: alto riesgo



Vision and market overview



1.2B People affected by presbyopia worldwide



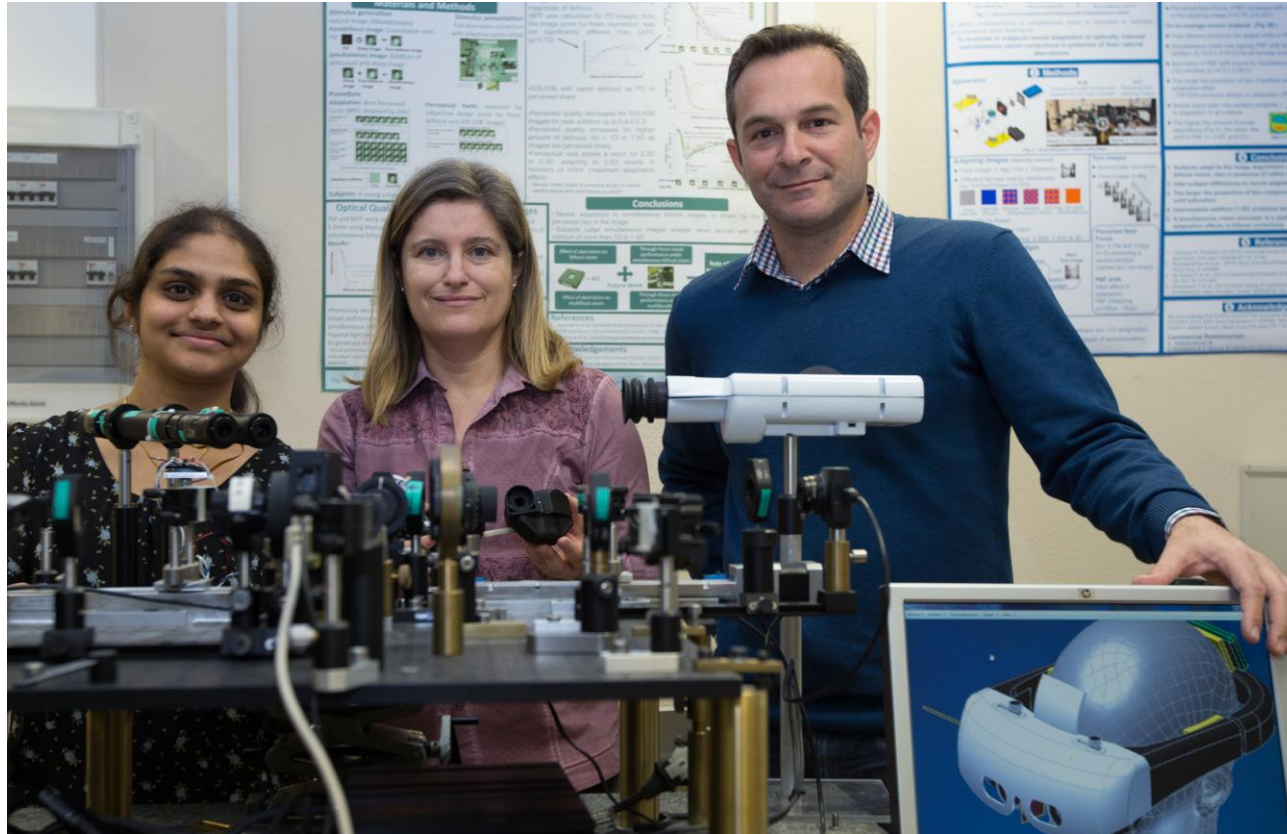
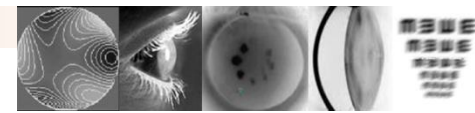
45M Contact lens users in the USA (>30% presbyopes)

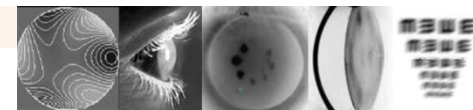


22M Cataract surgeries performed every year
(**4M** in the USA)



10-15% Penetration of multifocal lenses

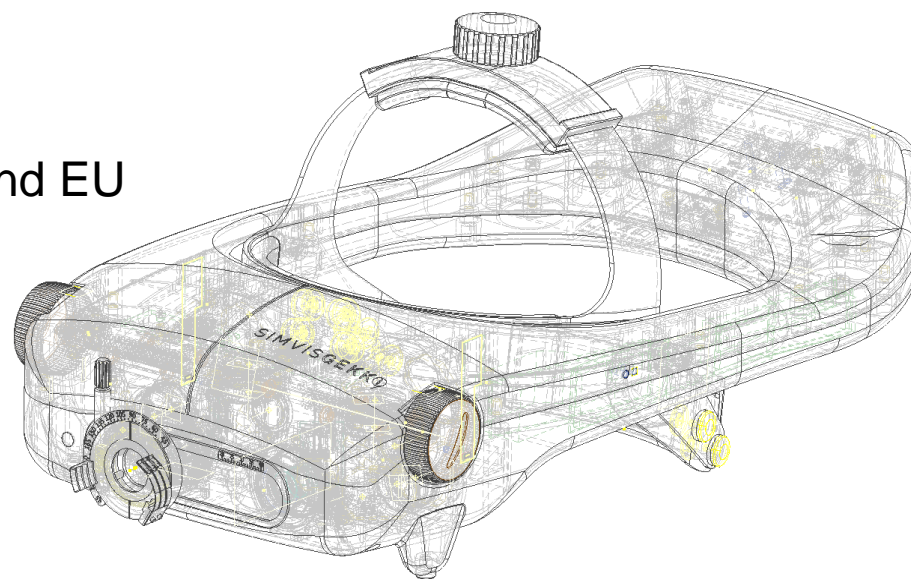


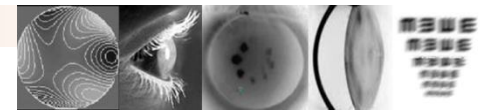


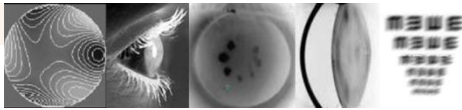
IP

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- ✓ The technology is protected by a family of 4 patents
 - ✓ 3 patents are property of CSIC (institution where the technology was developed)
 - ✓ the fourth is co-owned
- ✓ Key patents granted in USA and EU







ARTICLE

Differences in visual quality with orientation of a rotationally asymmetric bifocal intraocular lens design



Aiswaryah Radhakrishnan, MPhil, Carlos Dorronsoro, PhD, Susana Marcos, PhD



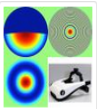
Portable simultaneous vision device to simulate multifocal corrections

Carlos Dorronsoro, Aiswaryah Radhakrishnan, Jose Ramon Alonso-Sanz, Daniel Pascual, Miriam Velasco-Ocana, Pablo Perez-Merino, and Susana Marcos

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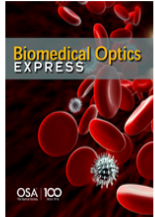
Optica Vol. 3, Issue 8, pp. 918-924 (2016) · <https://doi.org/10.1364/OPTICA.3.000918>



Temporal multiplexing to simulate multifocal intraocular lenses: theoretical considerations

Vyas Akondi, Carlos Dorronsoro, Enrique Gamba, and Susana Marcos

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Biomedical Optics Express Vol. 8, Issue 7, pp. 3410-3425 (2017) · <https://doi.org/10.1364/BOE.8.003410>

Research Article Vol. 9, No. 12 | 1 Dec 2018 | BIOMEDICAL OPTICS EXPRESS 6302
Biomedical Optics EXPRESS

Experimental validations of a tunable-lens-based visual demonstrator of multifocal corrections

VYAS AKONDI,^{1,3,*} LUCIE SAWIDES,² YASSINE MARRAKCHI,² ENRIQUE GAMBRA,² SUSANA MARCOS,¹ AND CARLOS DORRONSORO¹

Research Article Vol. 27, No. 3 | 4 Feb 2019 | OPTICS EXPRESS 2085
Optics EXPRESS

Tunable lenses: dynamic characterization and fine-tuned control for high-speed applications

CARLOS DORRONSORO,^{1,*} XOANA BARCALA,^{1,2} ENRIQUE GAMBRA,^{1,2} VYAS AKONDI,^{1,4} LUCIE SAWIDES,² YASSINE MARRAKCHI,² VICTOR RODRIGUEZ-LOPEZ,¹ CLARA BENEDI-GARCIA,¹ MARIA VINAS,¹ EDUARDO LAGE,³ AND SUSANA MARCOS¹

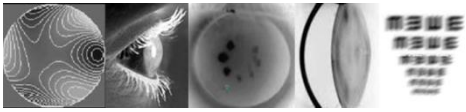
SCIENTIFIC REPORTS

Article | OPEN | Published: 07 February 2019

Visual simulators replicate vision with multifocal lenses

Maria Vinas, Clara Benedi-Garcia, Sara Aissati, Daniel Pascual, Vyas Akondi, Carlos Dorronsoro & Susana Marcos

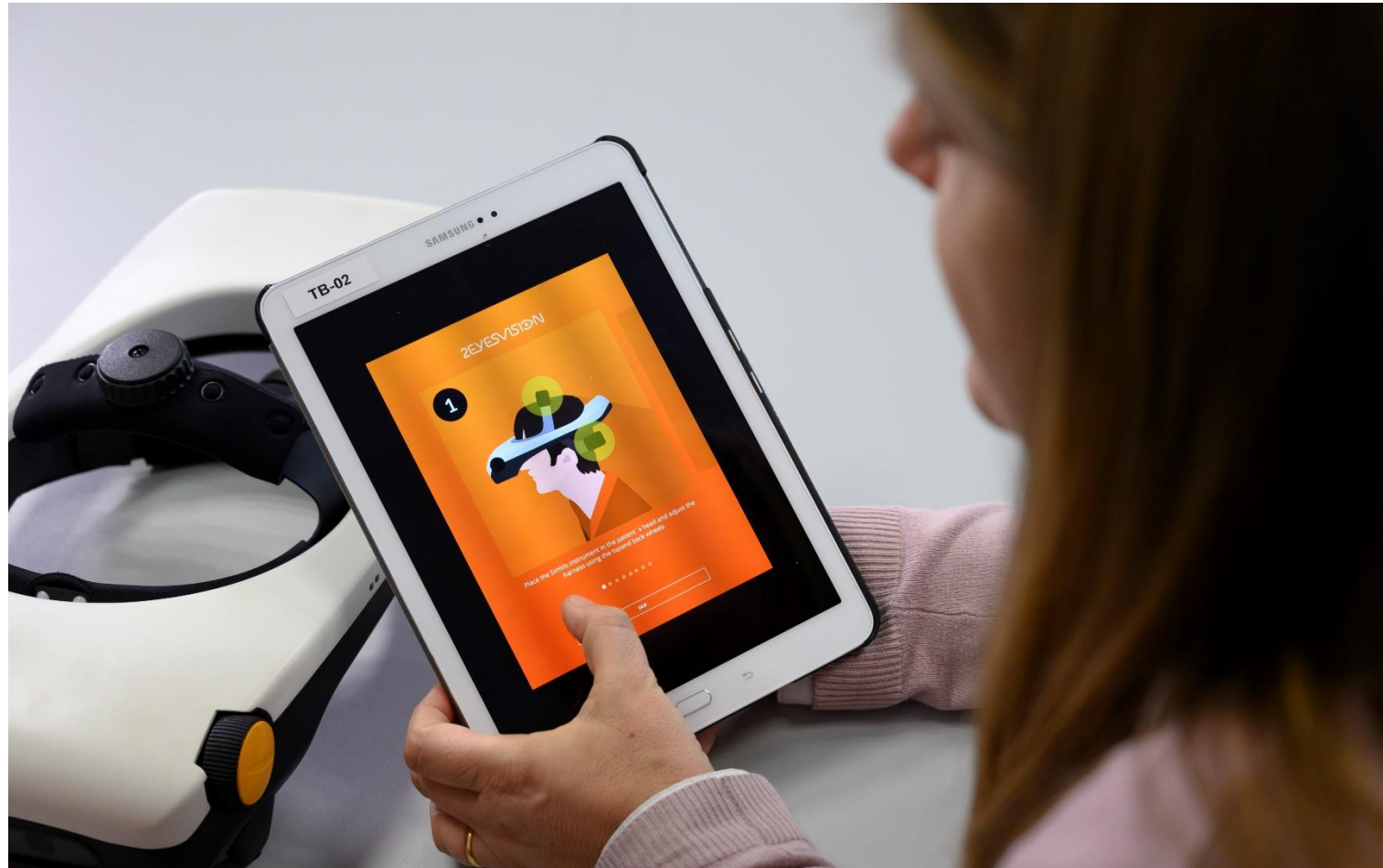
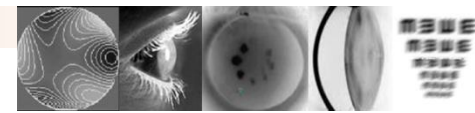
Scientific Reports 9, Article number: 1539 (2019) | Download Citation

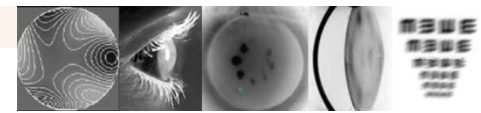


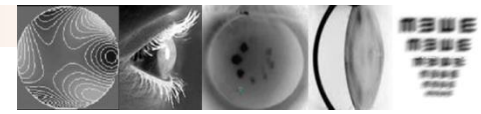
SimVis evolution

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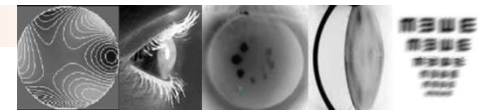


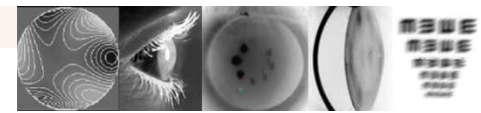


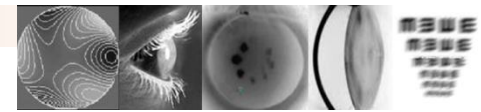


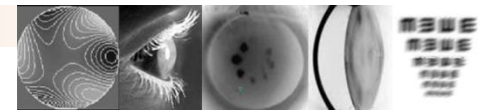
CARLOS DORRONSORO DÍAZ
INSTITUTO DE ÓPTICA DAZA DE VALDÉS

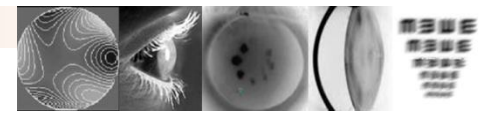












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Origen

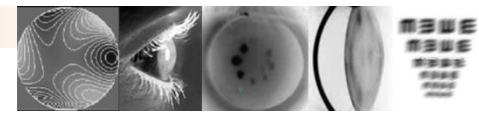
- KnowHow y patentes VioBio Lab (CSIC) 2008-2015 (ERC-AdG)

Creación

- Licencia fallida con terceros
- Socios: 2 promotores + 14 más (miembros del laboratorio y colaboradores)
- 4 Patentes licenciadas y explotadas

Crecimiento

- Desarrollos propios. Prototipos. Patentes, En colaboración con VioBio Lab
- Socios: 2 promotores + 15 socios entorno investigación + Inversores
- Capital social: 50K + Venture Capital (Bullnet Capital)
- Ingresos: Crecientes. Subvenciones (ERC PoC, H2020, TQ, EIT) y proyectos (JnJ)
- Business plan: Estable con diversificación
- Ventas “el año que viene”

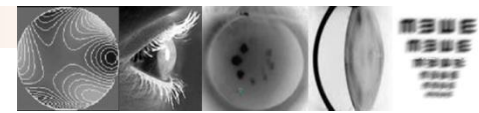


Conclusión

Empresas de base tecnológica:

Un canal óptimo

para proporcionar repercusión real,
impacto económico y social
a partir de logros científicos
resultantes de investigación orientada.



Claves

Hacer que suceda:

- Salir del laboratorio
- Formación
- Diseñar un buen equipo
- Conseguir ayudas
 - Mentores
 - Inversores

Hacerlo sostenible:

- Divertirse
- Encontrar una motivación a largo plazo
- Interiorizar el riesgo
- No preocuparse demasiado



Gracias!
carlos@dorrnsoro.com