CEVR
Centre for Eye and Vision Research
眼視覺研究中心

The Hong Kong Polytechnic University 香港理工大學
University of Waterloo

創新科技署 Innovation and Technology Commission
INNOHK

Driving Real-World Impacts in Eye and Vision Health Through Translational Research to Commercialization



轉化科研成果　提升視力健康
創新驅動商機　實現社會價值

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About CEVR
關於眼視覺研究中心

The Centre for Eye and Vision Research (CEVR) was established in 2020 by The Hong Kong Polytechnic University (PolyU) and the University of Waterloo (UWaterloo) under the InnoHK initiative of the Innovation and Technology Commission of the HKSAR Government.

眼視覺研究中心由香港理工大學與加拿大滑鐵盧大學在 2020 年合作成立，是香港特別行政區政府創新科技署「InnoHK 創新香港研發平台」的研發實驗室之一。

The mission of CEVR is to generate technologies to prevent vision loss in the ageing population and preserve healthy vision.

眼視覺研究中心的使命是研發創新科技，幫助長者預防視覺受損、保持視力健康。

Ground-breaking research in five key areas:
本中心在以下五個重點範疇展開開創性研究：



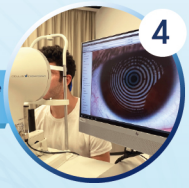
1 *Myopia and Eye Growth*
近視及眼睛生長



2 *Ocular Drug Discovery and Delivery*
眼科藥物研發和傳輸



3 *Vision Enhancement*
視力改進



4 *Tear Film and Ocular Surface*
淚液膜和眼表層



5 *Advanced Optometric Technology*
先進視光技術



PolyU and UWaterloo are renowned for their world-class optometry and vision science research. Harnessing the strengths of both host universities, CEVR's innovative technologies and products are poised to advance eye and vision health in Hong Kong, Canada and worldwide.

At CEVR, we foster multi-disciplinary research collaborations to develop innovative technologies and solutions for eye health. We see vast potential in applying our research to address the challenges faced by people with vision problems and to enhance overall vision health. Moving forward, we will leverage the collaboration between PolyU and UWaterloo to drive advanced research that tackles vision issues, ultimately improving the quality of life for billions globally.

香港理工大學和滑鐵盧大學以進行世界級的視光學和視覺科學研究而聞名於世。本中心借助這兩所大學的優勢，開發相關創新技術和產品，當能在香港、加拿大及全球各地促進人們的眼睛和視覺健康。

眼視覺研究中心積極推動跨學科研究協作，研發創新科技與解決方案，力求改善人們的眼睛健康。本中心的研究潛力無限，能運用研究結果，幫助視障人士應付困難，以及協助人們提升整體視覺健康。展望未來，我們將利用香港理工大學與滑鐵盧大學的協同效應，推進更多創新的視力研究，最終改善全球數以十億計人士的生活質素。

Professor
Benjamin THOMPSON
本杰明・湯普森教授

CEO and Scientific Director, CEVR
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香港理工大學眼科視光學院
科研眼科視光學訪問講座教授

World's First Quantum Technology in Vision Sciences

Structured Light Observation and Perception Evaluation (SLOPE) Device for the Assessment of Macular Health

Video 影片

全球首創檢測工具結合視覺科學與量子技術

結構光觀察及感知評估檢測儀用於評估黃斑區的健康



Awarded 榮獲獎項

Gold Medal with the Congratulations of the Jury at the 2024 International Exhibition of Inventions in Geneva
2024年瑞士日內瓦「國際發明展」評審團嘉許金獎

Gold Medal at the 2023 Asia Exhibition of Innovations and Inventions in Hong Kong
2023年亞洲創新發明展覽會金獎 – 香港

Special Prize from Lucian Blaga University of Sibiu, Romania in 2024
2024年由羅馬尼亞錫比烏盧西恩・布拉加大學頒發特別獎

Problems 問題

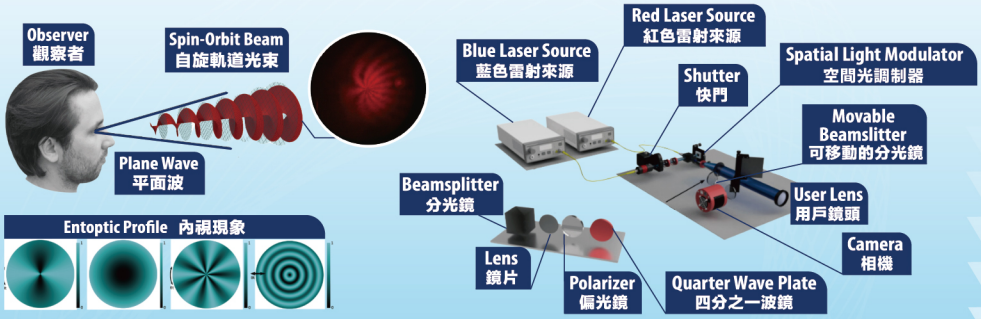
There are more than 200 million patients with Age-related Macular Degeneration (AMD) worldwide, but there is no current device for the pre-screening and detection of early AMD (an eye disease that affects central vision).

全球患有老年黃斑病變的患者超過兩億人，目前尚未有專門用於篩查和發現早期老年黃斑病變這種影響中央視力的眼疾的設備。

Solution 解決方案

SLOPE is a cutting-edge ophthalmic device for early AMD detection. By seamlessly integrating quantum light techniques and vision sciences, this technology significantly enhances the visibility of entoptic phenomena (visual effects that originate from within the eye), serving as a highly sensitive probe for detecting AMD.

結構光觀察及感知評估檢測儀是一種專門用以及早檢測老年黃斑病變的創新眼科診斷設備。該設備透過無縫地整合量子光技術和視覺科學，能夠大幅增強內視現象（即源自眼睛內部的視覺效果）的可見性，因此是檢測黃斑病變的高度靈敏工具。



Functions 功能

Generate a unique entoptic pattern. Healthy eyes can see the pattern clearly, while eyes with AMD have difficulty perceiving it.
產生獨特的內視圖案。健康的眼睛可以清楚看到旋轉圖案，但患有黃斑病變的眼睛卻很難觀察到該圖案。

Monitor visual performance objectively during AMD treatment.
在治療黃斑病變期間，客觀地監測患者的視力表現。

It can be used for routine eye examination and screenings, enabling the early detection of AMD, and reducing the risk of vision loss in patients.
該設備可用於常規眼科檢查和篩查，可及早發現老年黃斑病變，並降低患者喪失視力的風險。

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Augmented Reality (AR) Software Built to Aid the Visually Impaired

擴增實境賦能視障人士自助導航

Video 影片

Awarded 榮獲獎項

Gold Medal with the Congratulations of the Jury at the 2024 International Exhibition of Inventions in Geneva
2024年瑞士日內瓦「國際發明展」評審團嘉許金獎

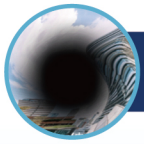
Gold Medal at the 2023 Asia Exhibition of Innovations and Inventions in Hong Kong
2023年亞洲創新發明展覽會金獎 – 香港



Problems 問題

Individuals with visual impairments may experience different types of vision loss. These can be caused by various factors such as accidents, underlying neurological or ocular conditions, or ageing. To navigate independently in their environments, visually impaired individuals require a safe, affordable, and technologically advanced solution that fits their individual impairment needs.

視障人士可能會有不同類型的視力受損情況，其成因可能是意外、內在神經病變、眼疾、年老等等多種因素。視障人士為要能夠在各自環境裏獨立走動，需要有安全、經濟實惠、技術先進、符合各自視力情況和需要的解決方案。


Central Vision Loss
中央視力缺失


Blurred Vision
視力模糊


Peripheral Vision
週邊視力

Solutions 解決方案

ObstAR is an augmented reality software which aims to provide visually impaired individuals with the means to navigate independently, minimizing the need for alternative assistive technologies such as guidance canes, dogs, or human assistance.

ObstAR 是一款擴增實境軟件，用以為視障人士提供獨立導航，從而減少對傳統輔助技術例如手杖、導盲犬或人力協助等的依賴。



Obstacle Detection Recognition and Distance Measurement
障礙物偵測、識別與距離測量



Scene Description
場景描述



Optical Character Recognition and Voice Instructions
光學字符識別及語音指令



Object Identification
物體識別

Functions 功能

Central Vision Loss 中央視力缺失

AR can be used to provide guidance in the missing portion of vision.
擴增實景技術可在缺失的視野區域提供導航指引。

Peripheral Vision Loss 週邊視力缺失

An arrow in the central field of view directs individuals on which way to go.
在中央視野中顯示箭頭，指示使用者應該前往的方向。

Other Visual Impairments 其他視力障礙

AR combined with voice instructions for safe navigation guidance.
擴增實景技術結合語音指令，提供安全的導航指引。

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Next-Generation Eye Product Testing Platform

Eye-On-a-Chip Device

Created for Researchers and Pharmaceutical Companies

Video 影片

Awarded Gold Medal 榮獲金獎

超越傳統方法精確測試眼部產品

眼睛晶片裝置

專為科研人員及製藥企業而設



Awarded 榮獲獎項

- Gold Medal at the 2025 International Exhibition of Inventions in Geneva
  2025年瑞士日內瓦「國際發明展」金獎
- Gold Medal at the 2024 Asia Exhibition of Innovations and Inventions in Hong Kong
  2024年亞洲創新發明展覽會金獎 – 香港
- CAI Award from the China Association of Inventions in 2024
  2024年中國發明協會創新發明獎（熊貓獎）

Problem 問題

Approximately 90% of ocular drugs fail in clinical trials, largely due to outdated preclinical testing methods. The U.S. Food and Drug Administration (FDA) Modernization Act 2.0 now permits in vitro alternatives to animal testing for pre-clinical screening. However, the current in vitro methods for evaluating ocular drugs still rely on simplistic cell culture models that inadequately replicate the eye's complex environment. This limitation compromises the accuracy, reliability, and relevance of the test results. Utilizing more advanced in vitro models would accelerate the research progress while significantly reducing the R&D costs and resources.

眼科藥物在臨床試驗階段試驗失敗的機會高達 90%，主要原因是使用了過時的臨床前測試方法。美國食品藥物管理局的現代化法案 2.0 現允許使用體外測試進行臨床前篩查，取代動物試驗。然而，目前用以評估眼科藥物的體外測試方法仍然依賴簡單化的細胞培養模型，這些模型難以有效模擬眼睛的複雜環境。此項限制影響了測試結果的準確性、可靠性和相關性。利用更先進的體外測試模型，將能加快研發進度，同時顯著降低研發成本和所需資源。

Solution & Functions 解決方法及功能

The Eye-On-a-Chip Device mimics the ocular environment for testing eye products, including ophthalmic solutions, pharmaceuticals, and devices. It employs microfluidics to simulate tear flow and uses real-time imaging with an automated analysis algorithm to measure cell health. Designed for easy integration with existing lab setups, it saves time and money, streamlines research, and produces more accurate, clinically relevant data.

眼睛晶片裝置可模擬眼睛的微環境，以便測試各類眼科產品，包括眼科溶液、藥品和設備等。這個裝置利用微流控技術模擬淚液流動情況，同時採用自動化影像分析的專利技術來實現實時成像功能，以便測試細胞的健康狀況。該裝置的設計方便與現時的實驗室設備互相整合，有效節省成本和時間，簡化研究過程，並產生更加準確和可靠的臨床相關數據。



- **REDUCES** ~50% of the research time per researcher
  減少每個研究人員 50% 的研究時間
- **SAVES** **HKD 150-300K** per year / researcher
  每年每一研究人員可 **節省15萬至30萬港元** 研究人員的開支
- **RELEVANT** measurements due to an eye-mimicking environment
  模擬眼睛環境，提升產品測試數據的 **相關性**
- **STANDARDIZED** and validated results
  標準化 和經過驗證的結果

- **Streamlined** R&D process **簡化** 研發過程
- **Faster** product testing **加快** 測試產品
- **Better** predictive responses **更佳的** 反應預測

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Baicalein 黃芩素 | Cell membrane 細胞膜 | Nanocarrier 納米載體

Biomimetics Nanoplatform for the Treatment of Retinal Diseases
仿生納米平台 用於精準治療視網膜病變

Video 影片



Silver Medal
at the 2025 International Exhibition of Inventions in Geneva
2025年瑞士日內瓦「國際發明展」銀獎

Problem 問題

Current drug treatments for retinal diseases present several challenges. Many medications lack targeting specificity, leading to off-target and undesirable side effects. For glaucoma, the prolonged use of single or multiple eye drops often results in drug resistance due to the cumulative side effects, which can reduce patient adherence and long-term efficacy. Additionally, treatments specifically targeting retinal inflammation are limited and may suffer from limited drug stability, predisposing them to degradation before reaching the target site. These issues highlight the need for more targeted, stable, and sustained-release treatments.

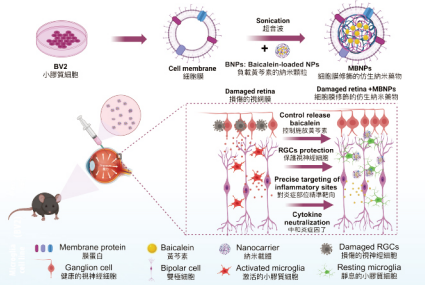
目前針對視網膜病變的藥物治療方法面臨幾個挑戰。許多藥物缺乏靶向性，導致非靶向效應和不必要的副作用。對於青光眼而言，長期使用單一種或多種眼藥水的話，患者的眼睛往往會因累積副作用而產生抗藥性，這情況可能會降低患者的用藥依從性及長期療效。此外，專門針對視網膜炎症的治療方法有限，並且可能存在藥物穩定性不足的問題，使藥物容易在尚未到達靶點便已降解。這些問題凸顯了治療方法需要有更高的靶向性、穩定性和持續放藥能力。

Solution 解決方案

The biomimetics nanoplatform addresses the limitations of retinal disease treatments by utilizing natural immune cell membrane materials to create a biomimetic nanodrug delivery platform. This platform leverages precise biorecognition to target and deliver drugs directly to sites of neuroinflammation in the retina, facilitating more controlled drug release. In addition, it protects unstable and easily degradable drugs, enhancing the therapeutic efficacy while minimizing the off-target effects.

仿生納米平台通過利用天然免疫細胞膜材料，開發一種仿生納米藥物施放平台，旨在解決目前視網膜疾病治療藥物的局限性。該平台利用精確的生物識別，將藥物靶向性地施放至視網膜炎症部位，實現藥物的受控施放。此外，這個平台還能保護不穩定而且易降解的藥物，在減少藥物脫靶情況之餘，更提高治療效果。

Illustration of Membrane-coated Nanoparticles (MBNPs) and Therapy Mechanism
細胞膜修飾的仿生納米藥物和治療視網膜疾病機制示意圖



Functions 功能

Precise Targeting of Inflammatory Sites 對炎症部位精準靶向

The nanoplatform leverages the natural chemotaxis and biological receptors of BV2 microglia cell membranes to specifically identify and target inflamed cells in the retina, thereby improving the drug delivery accuracy.

該納米平台利用BV2小膠質細胞膜的天然趨化特性及生物受體，能精準識別視網膜中的炎症細胞並對其靶向，從而提升藥物施放的準確性。

Enhanced Drug Stability and Biocompatibility 提高藥物穩定性與生物相容性

By encapsulating unstable drugs like baicalein, the platform significantly improves their stability against degradation and prolongs their half-life, leading to superior therapeutic outcomes.

該平台通過包裹不穩定藥物（如黃芩素），能顯著提高藥物的抗降解能力，並顯著延長其半衰期，從而實現超卓的治療效果。

Reduced Side Effects 減少副作用

The precise targeting and controlled release of drugs minimize off-target effects, reducing systemic toxicity and side effects compared to conventional treatments.

透過藥物的精準靶向和受控施放，這平台有效降低藥物脫靶的情況，減少發生傳統治療方法常見的系統性毒性和副作用。

Modulation of the Immune Response and Cytokine Neutralization 調節免疫反應與中和細胞因子

The platform neutralizes pro-inflammatory cytokines (e.g., IL-6, TNF-α) and regulates microglia activity, effectively suppressing neuroinflammation and protecting retinal neurons.

這平台可以中和促炎細胞因子（如IL-6、TNF-α），並調節小膠質細胞活性，從而有效抑制神經炎症，保護視網膜神經元免受損傷。

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NUOVO Vision

Neuromodulation Solutions for Presbyopic Vision

腦神經調節技術改善老花眼視力



Problem 問題

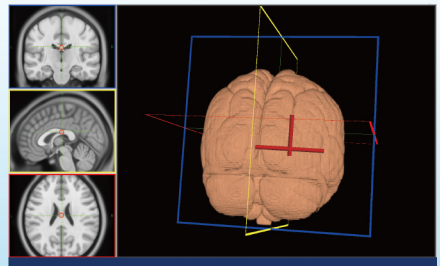
Presbyopia is an age-related condition that affects the ability to see objects up close clearly. As we age, the lens inside our eyes become less flexible, making it difficult to focus on near objects, such as when reading, resulting in blurry vision. This impairment in vision is not just optical; it also impacts how our brain processes visual information. When image clarity decreases, the brain's response to visual stimuli becomes slower and weaker. This dual impact – both optical and neural – contributes to the difficulties experienced with near vision in presbyopia. Current management options, like glasses and contact lenses, aim to improve the optical quality, but they do not address the underlying neural processing involved in vision.

老花是一種與年齡相關的狀況，會使我們難以看清近處的物件。隨著年齡增長，眼內晶狀體的彈性變差，導致雙眼難以聚焦於近處的物件（例如在閱讀時），以致視線模糊。這種視力受損情況不只是視光性問題，更會影響我們的大腦如何處理視覺信息。當影像清晰度降低時，大腦對視覺刺激的反應會變得更慢、更弱。這種涉及視光層面和神經層面的雙重影響共同促使了老花眼在近距離視物時的困難。現有的處理方式，例如佩戴眼鏡或隱形眼鏡，旨在提升視光上的質量，但並未解決視覺中涉及的內在神經處理問題。

Solution 解決方法

NUOVO Vision is focused on developing innovative approaches that specifically target the neural aspects of vision in presbyopia. Our method enhances neural processing through non-invasive brain stimulation, allowing for improved residual vision without the need for near optical correction.

NUOVO Vision 專注於開發創新的方法，專門針對老花眼視覺涉及的神經層面問題。我們的方法是通過非侵入性腦部刺激來增強神經處理，從而改善殘餘視力，無需依賴近距離的視光矯正。



Non-invasive Brain Stimulation
非侵入性腦部刺激

Function 功能

Our approach uses non-invasive brain stimulation combined with visual training to improve how the brain processes visual information. This technique enhances the brain's ability to learn and adapt, a process known as neuroplasticity. Non-invasive brain stimulation is a safe and painless method that helps enhance the brain's capacity to strengthen and form new connections, allowing for better visual processing and function in impaired visual states.

我們的方法結合了非侵入性腦部刺激和視覺訓練，以改善大腦處理視覺信息的方式。這項技術能夠增強大腦學習和適應的能力，而這一過程也被稱為神經可塑性。非侵入性腦部刺激是一種安全無痛的方法，有助提升大腦加強和形成新的連接的能力，從而在視覺受損的情況下，仍可得出較佳的視覺處理效果和功能。

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CEVR Centre for Eye and Vision Research 眼視覺研究中心

The Hong Kong Polytechnic University 香港理工大學 | University of Waterloo

創新科技署 Innovation and Technology Commission

INNOHK

Opening Up Possibilities to Enhance Vision

Together, We See Further

視界無限
共創成就非凡未來

Centre for Eye & Vision Research