IX JORNADA DE JÓVENES INVESTIGADORES DEL I3A

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Influence of Field of View in Visual Prostheses Design: Analysis with a VR System

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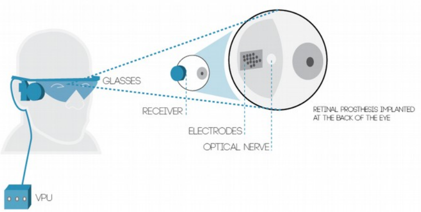
Motivation

Healthy vision

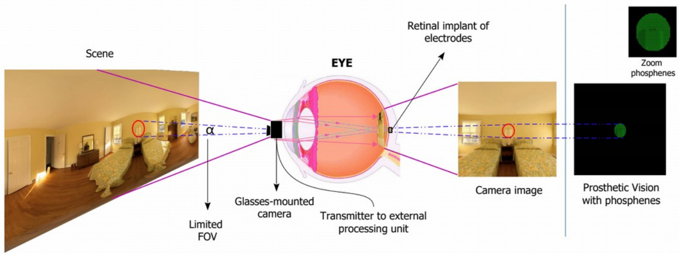
Limited vision

Retinal prosthesis



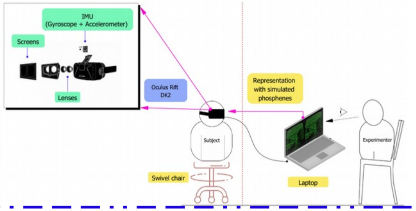
Retinal prostheses are designed to restore partial functional vision in patients with total vision loss.

Overview



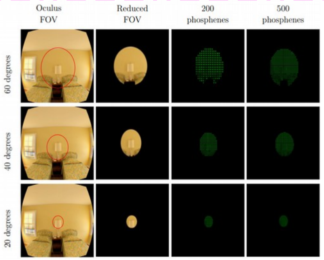
- Retinal prostheses provide limited capabilities as a result of low resolution, limited field of view and poor dynamic range.
- Understanding the influence of these parameters in the perception results can guide prostheses research and design.

Simulated prosthetic vision (SPV) and Evaluation



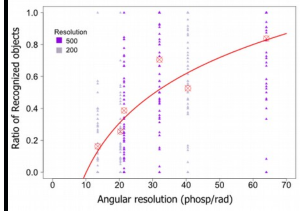
We use a new SPV system that allows simple and effective experimentation. Our system uses a virtual-reality environment based on panoramic scenes. The simulator employs a head-mounted display which allows users to feel immersed in the scene by perceiving the entire scene all around.

We evaluate the influence of FoV with respect to spatial resolution in visual prostheses, measuring the accuracy and response time in a search and recognition task.

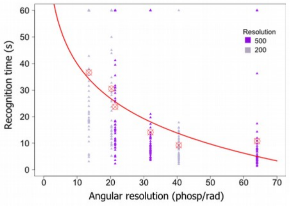


Twenty-four normally sighted participants were asked to find and recognize usual objects, such as furniture and home appliance in indoor room scenes.

Results and Conclusions



(a)



(b)

Table 1. Mean value of the ratio of recognized object and recognition time for the six angular resolutions. Parameters for logarithmic regression and R^2, F-value and p-value.

Angular resolution (phosp/rad)	Ratio of recognized object	Recognition time (s)	# Results > 60 s
13.5	0.166 ± 0.058	36.61 ± 5.77	20
20.3	0.197 ± 0.059	30.50 ± 5.79	14
21.4	0.346 ± 0.078	23.71 ± 4.91	7
32.0	0.638 ± 0.087	14.10 ± 4.41	4
40.5	0.602 ± 0.083	9.24 ± 2.35	1
64.0	0.807 ± 0.076	10.81 ± 4.32	4
Intercept	−1.0345	83.14	–
Slope	0.4482	−18.78	–
R^2	0.4031	0.2344	–
F-value	201.3	91.26	–
p-value	***	***	–

- Angular resolution is major determinant for effective object recognition, being directly correlated to the accuracy and inversely correlated to the response time.
- Our results seem to indicate that it is better to concentrate the phosphenes to maximize the angular resolution, sacrificing field of view.
- Our experimental setup relies on a consumer-level head-mounted display, public image databases and we have released the software needed to run the simulator, to facilitate replications and extensions.

References

[1] Sanchez-Garcia M,Martinez-Cantin Rand GuerreroJ J2020 Semantic and structural image segmentation for prosthetic vision PLoS ONE 15e0227677

[2] Perez-Yus A, Bermudez-Cameo J, Lopez-Nicolas G and Guerrero J J 2017 Depth and motion cues with phosphene patterns for prosthetic vision Proc. of the IEEE Int. Conf. On Computer Vision Workshopspp1516–25

Acknowledgements

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