The digital world is offering an amazing range of possibilities for everyone, especially for people with disabilities. Come and join us as a **Master 2 intern** to leverage new technologies to offer life-changing solutions for people with visual impairment.

Towards Large-Scale Evaluation Protocols for the Visually Impaired

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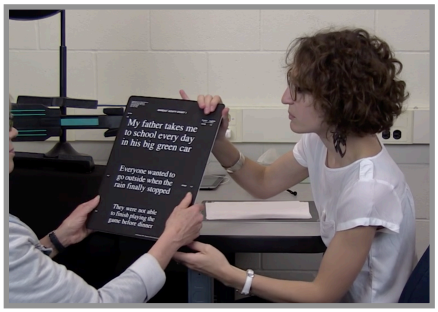
CONTEXT: In 2015, 405 million people were visually impaired around the globe, against 'only' 285 million in 2010 [1]. Almost half of it could have been prevented by **earlier interventions** in the form of treatment or rehabilitation. Because of **aging**, and its strong correlation with eye disease prevalence, this number is only expected to grow. To address this global health problem, actions must be taken to design effective solutions for earlier and **more decisive detection of visual pathologies**.



PROBLEM: Since reading speed is a strong predictor of visual ability and vision-related quality of life for patients with vision loss, **reading performance** has become one of the most important clinical measures for judging the effectiveness of treatments, surgical procedures or rehabilitation techniques. Accurate measurement of reading performance requires highly standardized reading test, such as the **MNREAD acuity chart** [2]. This test, available in 19 languages, allows to measure reading performance in people with normal and low vision. In brief, performance is measured from the time needed to read a **series of short sentences** that were designed to be equivalent in terms of linguistics, length and layout. To ensure accurate measurement, each sentence must be presented only once to avoid introduction of a memorization bias. However, because of their **highly constrained** nature, MNREAD sentences are hard to produce, leading to a very limited number of test versions (only two in French). Given that repeated measures are needed in many applications of MNREAD, there is a strong interest from the scientific and medical communities for a much **larger pool of sentences**.

STATE-OF-THE-ART: Very recently, a method for **computer-generated sentences** has been explored by the MNREAD creators themselves [3]. However, this semi-automated method presents several major drawbacks: (1) it relies on sentence templates that must be created manually (i.e., sequences of placeholders, each containing a list of possible words that fit into the sentence at that point); (2) it works in two stages (i.e., sentence creation followed by sentence selection) implying additional calculations and longer execution time; (3) it can not be extended to other languages.

SHORT-TERM OBJECTIVE (Internship research program): Fully automated generation of constrained text is a very complex task. The problem that we must solve here is to generate a very

large number of sentences, while taking into account very strict linguistics, length and layout constraints, such as: fixed number of characters, restricted vocabulary (3rd grade level), tightly constrained physical layout, etc. To tackle this matter, one approach we will consider is oriented towards the **automatic production of constrained text from a corpus**. However, to further extend the test capabilities, we must keep the option to modify these constraints along the course of our project. Therefore, it is crucial to consider **methods based on constraints satisfaction**, such as those developed by J.C. Régin at I3S, in collaboration with the Sony Computer Science Lab [4]. These methods are essentially based on multivalued decision diagrams and the operations that allow them to be manipulate [5,6,7], and have already proven to be efficient [8].

PERSPECTIVE: In the short run, the MNREAD Android app will serve as a research tool, allowing for instance to generalize the principles of the test to evaluate the effects on reading of dependent variables other than print size e.g., evaluate the readability of a new typeface, letter spacing and line length. In the long run, the MNREAD Android app may be commercialized to serve as a valuable tool in clinical settings.

BIBLIOGRAPHY:

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[3] Mansfield, J.S., Atilgan, N., Lewis, A.M., Legge, G.E. (2019) Extending the MNREAD sentence corpus: Computer-generated sentences for measuring visual performance in reading. Vision Research, 158, 11–18.

[4] Papadopoulos, A., Roy, P., **Régin, J.-C.,** Pachet, F. (2015) Generating all Possible Palindromes from Ngram Corpora. IJCAI 2015: 2489-2495

[5] Perez, G., **Régin, J.-C.** (2015) Efficient Operations On MDDs for Building Constraint Programming Models. IJCAI 2015: 374-380

[6] Perez, G., **Régin, J.-C.** (2017) Soft and Cost MDD Propagators. AAAI 2017: 3922-3928

[7] Perez, G., **Régin, J.-C.** (2018) Parallel Algorithms for Operations on Multi-Valued Decision Diagrams. AAAI 2018: 6625-6632

[8] Perez, G., **Régin, J.-C.** (2017) MDDs: Sampling and Probability Constraints. CP 2017: 226-24

SUPERVISORS: The candidate will be co-supervised by P. Kornprobst, a mathematician with strong expertise in computer vision and human vision understanding, J.C. Régin, a world-wide known specialist in constraint programming, and A. Calabrèse, a psychophysicist specialized in visual neuroscience with a strong clinical expertise.

CONDITIONS:

- Duration: 6 months
- Starting date: February/March 2020
- Where: Inria Sophia Antipolis - Méditerranée, France (https://www.inria.fr/en/centre/sophia).
- Salary: ≈ 550 euros per month.

CURRICULUM OF THE CANDIDATE: Applicants should have a keen interest in linguistic, low vision or both, and a relevant Master, for example in natural language processing, computer science, digital humanities or linguistics.

FOLLOW-UP: Funding opportunities to continue for a 4 year Ph.D. including a six month period in the US.

TO APPLY: Please visit https://team.inria.fr/biovision/job-offers.