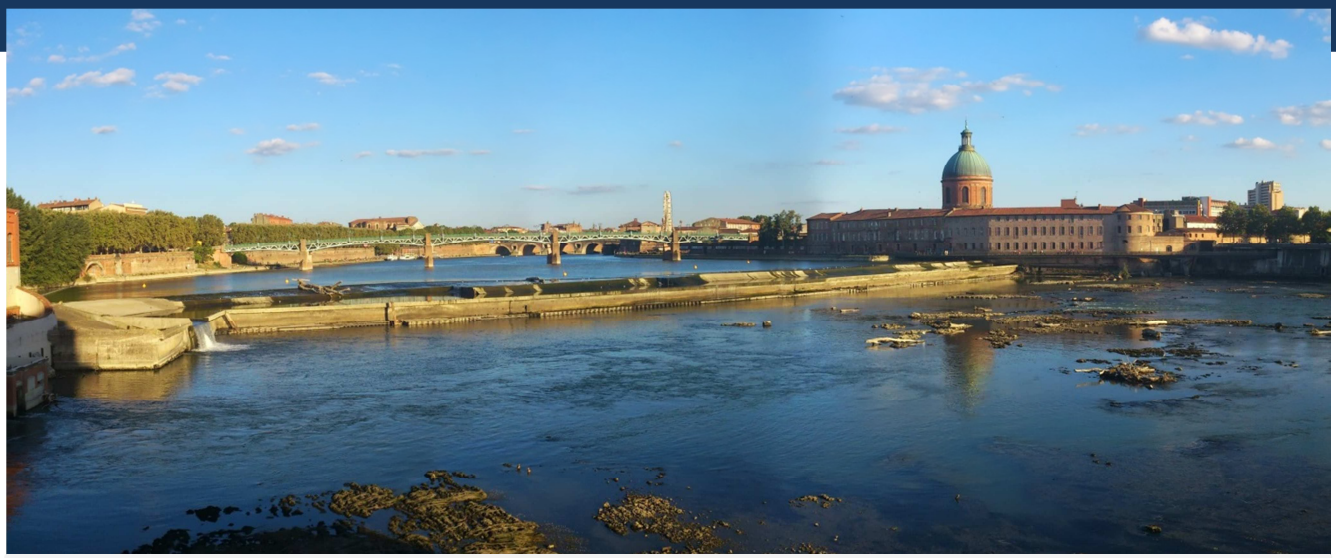

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Pilot's head tracking as a proxy for gaze tracking

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Content

Eye tracking is often used in aviation to study the pilot's visual circuits, which are relevant to the first two stages of eye tracking integration 1. However, the sensors can be expensive or difficult to integrate in a cockpit and can be sensitive to light variations. We propose to start studying the movements of the pilot's head as a proxy of their visual interest, because the sensors are already integrated in many virtual reality setups and are not so expensive. Of course, the data quality can't be considered as good, because the pilot can move their eyes without moving their head. Therefore, the goal of this study is to qualify the interest of the pilot's head tracking.

We collected head movements data in virtual reality flights in a light plane using a two-phases protocol:
1) A calibration phase asking the pilot to look at some specific points
2) A list of simple flight phases (climb, turn...)
The calibration phase is useful because some pilots move their head a lot whereas some other pilots move their eyes more.

The virtual reality headset used, the Oculus Rift, already includes some correction signal processing and outputs the head's orientation [2].
We then defined some areas of interest (AOIs):
• Outside the cockpit, ahead
• Outside, left
• Outside, right
• Primary flight instruments
• Secondary flight instruments
• Low (e.g. looking at a map on one's knees)
and we analyzed the flight by slicing it into different flight phases.

We observed a few interesting preliminary results. For instance, the search for a nearby traffic generates broader than usual head movements. In a turn, the pilot turns their head to the side but also moves it downwards because their vision is obstructed by the roof of the plane. During a climb, there are some downwards head movements, towards the flight instruments, but they are a lot smaller than during a turn, seemingly showing that eye movements are mostly sufficient to obtain the necessary information. Finally, experienced pilots seem to move their head less than beginners, maybe because they use more peripheral vision consistently with [3].

Additional data will be necessary to make these results more robust. In future analyses, we also plan to use more formal statistical metrics to describe the pilot's visual circuits, as well as further signal processing to detect some abnormal pilot states (unconscious pilot, pilot in attentional tunneling...). We will also further study the differences in head behaviour between experienced and beginner pilots. We will start integrating IMUs on the pilot's head in real flights as well.

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[3] Fox, Julianne, et al. "Information extraction during instrument flight: An evaluation of the validity of the eye-mind hypothesis." Proceedings of the HFES Annual Meeting. 1996.

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