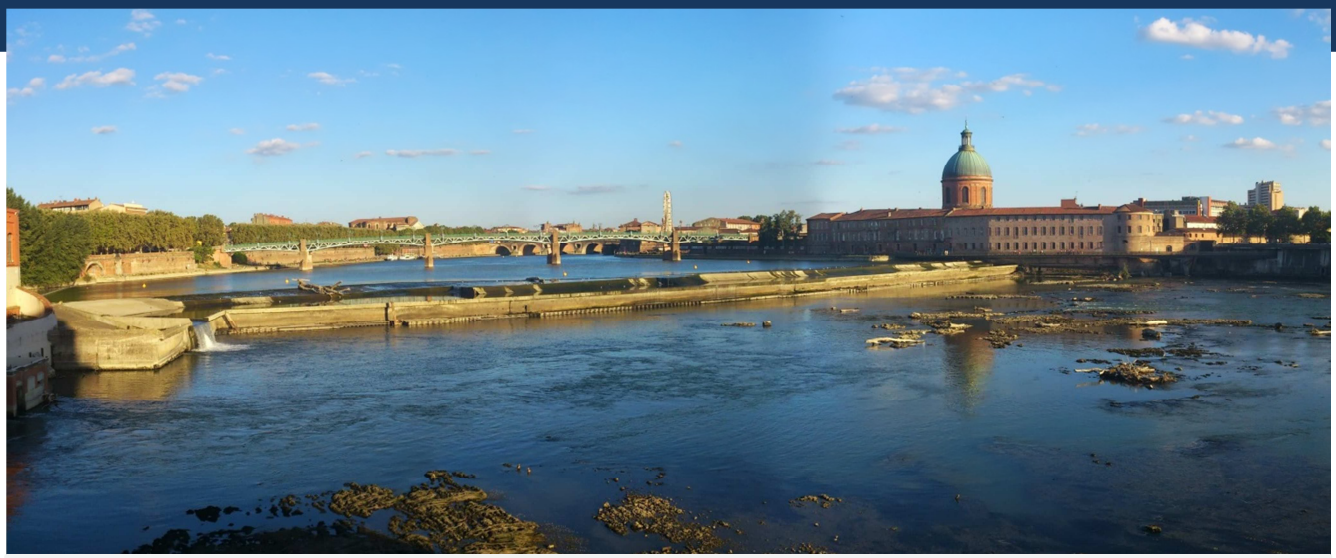

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Bridging the gap between human visual anticipation and autonomous systems through the use of a vector addition model

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Content

Visual anticipation is an essential cognitive function in that it is necessary for action and is considered a key feature of Endsley's situational awareness model (1995, 2015). In recent decades, both research and industry have shown a growing interest in autonomous vehicles and, in this context, anticipation raises new questions. Indeed, human performances in automation situations decrease (e.g., complacency, degradation of skills and loss of situational awareness). Various causes are described by Victor et al. (2018), but an important one is the operators' gap and misconceptions in their mental models of automated systems (Sarter & Woods, 1994). Surprised by automation; they do not know what behaviour the system will produce (Parasuraman et al., 2008), leading to inappropriate and therefore dangerous reactions. The objective is then to identify the mechanisms of visual anticipation to model how individuals anticipate events. Such modelling will facilitate the implementation of autonomous system anticipation algorithms that are more compatible with the mental model of users. The anticipation mechanism that has been firmly identified is called *representational momentum* (RM). Numerous studies have shown that the RM is sensitive to factors present in the context of driving a vehicle. And while some factors promote anticipation, others hinder it.

Blättler et al. (2010, 2011) have shown that specific experience in driving and aviation domains facilitates anticipation in these specific contexts unlike inexperience that strongly degrades it. Blättler et al. (2012) have shown that involvement in the driving action is also a facilitating factor. People tend to be distracted by dual-tasks that affect their attention level, but studies on anticipation and attention do not yet give clear results. While Hayes and Freyd (2002), Joordens et al. (2004) and Blättler et al. (2019) show a facilitating effect of divided attention, other research (Kerzel, 2004; Hubbard et al., 2009) show different effects. Furthermore, Blättler et al., (2019) show a facilitating effect if one has experience in the situation and an opposite effect if one is inexperienced.
According to Hubbard's (2010) model, the RM is a mechanism allowing to extrapolate the movement of a moving object or scene in the direction of its movement based on a variety of factors. Each influencing factor is represented by a vector coding for the direction and magnitude of the extrapolation. If the context provides several vectors coding for a direction opposite to the motion, the result of the process should be a spatial representation shifted not forward but backward. Conversely, vectors fostering an extrapolation in the direction of movement, then anticipation should occur.

Therefore, it is first necessary to identify in autonomous vehicle contexts which vectors are involved and what will be the result of the anticipation process in individuals (model definition). Then, it will be necessary to test the most appropriate configurations of the driver's cab to favour the expression of anticipation (model test). Finally, the reactions of an individual in an autonomous vehicle against an appropriate and inappropriate configuration will be tested to measure the risks of the inappropriate configuration for anticipation.

Keywords : Man-machine cooperative techniques