8 Driver Activity and Notification Demands

The number (particularly that of non-driving tasks) and the complexity of activities inside the car – as shown in Fig. 8.1 – has risen constantly in the last years. One possible consequence of this development is an increase in driver distraction [99] which needs to be avoided or compensated as much as possible in order to ensure safe and accident-free vehicle control. A second issue is that most of the vehicular systems (see righthand side of Fig. 8.1) deliver feedback on the car’s status (which cannot be switched off) to the driving person and thus, lead to information overload and driver distraction.

![Diagram of Driver Activities and Notification Demands]

Fig. 8.1: Driver activities and notification demands when operating a car.

Since different activities require more or less active cooperation of the driver (and therefore result in a higher or lower level of distraction), and occur infrequently (internet inquiries) or often (navigation), a universal, appropriate and comfortable solution has to consider the required level of attention for a certain notification demand (such as ignore, interest, action) while taking the driver’s current mental state (e.g. smooth, stressed, heavily disturbed, etc.) into account – the concept of raising a certain attention-level is introduced in the Section “Level of Attention (LOA)” on p. 101.

Further potential for decreasing driver distraction is attributed to multimodal, instead of unimodal, feedback. A detailed discussion on multimodality is given in both Chapter “Multimodal” on p. 21 and in Vernier et al. [288].

Allen [5] has provided a means of combining multiple modalities into a single composite modality as shown in Fig. 8.2. To do so, he addressed the problem of reasoning about qualitative temporal information and in particular gave an algorithm for computing an approximation to the strongest implied relationship for each pair of intervals.

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**Combination Schemas**

<table>
<thead>
<tr>
<th>Combination Aspects</th>
<th>TEMPORAL</th>
<th>SPATIAL</th>
<th>SYNTACTIC</th>
<th>SEMANTIC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anachronism</td>
<td>Sequence</td>
<td>Concomitance</td>
<td>Coincidence</td>
</tr>
<tr>
<td></td>
<td>Separation</td>
<td>Adjacency</td>
<td>Intersection</td>
<td>Overlaid</td>
</tr>
<tr>
<td></td>
<td>Difference</td>
<td>Completion</td>
<td>Divergence</td>
<td>Extension</td>
</tr>
<tr>
<td></td>
<td>Concurrency</td>
<td>Complementary</td>
<td>Complementary and Redundancy</td>
<td>Partial Redundancy</td>
</tr>
</tbody>
</table>

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Fig. 8.2: The five Allen relationships applied to the four combination aspects temporal, spatial, syntactic, and semantic (adapted from Allen [5]).

### 8.1 Notification-Induced Driver Distraction

The driving person is continually burdened with notifications from the different vehicular systems, the environment and requests initiated by the driver himself. The vast amount of information delivered to the driver is probably a reason for distraction and therefore attention must be focused on this topic in order to prevent or compensate for distraction.

Distracted driving is part of the broader category of driver inattention and occurs “when a driver is delayed in the recognition of information needed to safely accomplish the driving task because some event, activity, object or person [...] compelled or tended to induce the driver’s shifting attention away from the driving task” (American Automobile Association Foundation for Traffic Safety) [289, p. 21], [290], [270].

Royal [291, p. 3] states that about 3.5% of all drivers in the US (up to 8.3 million) that have been involved in a crash attribute it to them being distracted. The National Highway Traffic Safety Administration (NHTSA) estimated that driver distraction contributes to approximately 13% of crashes reported to the police (Young et al., [290, p. V]). In 2004, automobile manufacturer General Motors issued a public statement which suggested that driver distraction

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43 The five relationships presented here, together with the four inverse relationships, are a subset of all thirteen possible relationships in which an ordered pair of intervals can be related. Originally the temporal relation “coincidence” was segmented into three relations [5, p. 4].

44 Inattention refers to any condition, state or event that causes a driver to pay less attention than required for the driving task [270].