Abstract
In human supervisory control, machines control the process according to directives given by human operators, where the humans have the final authority over the machines or automation. There are many human-machine systems in our society that are modelled nicely by the human supervisory control model. A glass-cockpit passenger aircraft is a typical example of such a system. However, even in transportation, human-automation relation for technologically advanced automobile may be quite different from that for a glass-cockpit aircraft. In automobile, it is only the automation that may be able to help the driver by backing up or replacing him/her to assure safety: Neither air traffic controller-like function nor copilot like colleague is available there (Inagaki 2010).

An advanced driver assistance system (ADAS) is a machine to assist a human to drive a car in a dynamic environment. Some functions of ADAS may include: (a) perception enhancement that helps the driver to perceive the traffic environment around his/her vehicle, (b) arousing attention of the driver to encourage paying attention to potential risks around his/her vehicle, (c) setting off a warning to urge the driver to take a specific action, and (d) automatic safety control that is activated when the driver takes no action even after being warned or when the driver’s control action seems to be insufficient.

The first two functions, (a) and (b), are to help the driver to recognize or understand the situation. Understanding of the current situation determines what action needs to be done (Hollnagel & Bye 2000). Once situation diagnostic decision is made, action selection is usually straightforward (Klein 1993). However, the driver may not be successful in action selection decision. Function (c) is to help the driver in such a circumstance. Any ADAS that uses only the three functions, (a) – (c), is completely compatible with the human-centered automation principle (Billings 1997) in which the human is assumed to have the final authority over the automation.

Suppose an ADAS contains the forth function, (d). Then the ADAS may not be fully compatible with the human-centered automation, because the automation can implement a safety control action without any human intervention. Should we ban such an ADAS just because it can implement an action that is not ordered by the driver?

It is well known that highly automated machines sometimes bring negative effects, such as the out-of-the-loop performance problem, loss of situation awareness, complacency or overtrust, automation surprises. However, humans have limited capabilities, and they might fail to understand the situation, select a right action and
implement it appropriately, especially when available time and information are quite limited. Today’s machine can sense and analyze a situation, decide what must be done, and implement control actions. Now is the time to discuss how such a smart machine (or automation) can help the humans in more a positive manner as a teammate to the humans.

What if an error in situational understanding has occurred in spite of such assistances for perception and cognition and if an ‘erroneous’ behavior of the driver has been detected? A natural action for the ADAS would be to set off warnings to urge the driver to stop or correct the ‘erroneous’ behavior. Warnings are expected to assist the driver’s action selection. Suppose the driver did not respond to the warnings. Does the ADAS perform nothing but observe consequence of the driver’s ‘erroneous’ behavior to occur? Or, may the ADAS take some control action to avoid such a consequence? Answers to the questions are not so simple. When the control action is not directed by the driver but is decided by the ADAS, an issue of authority and responsibility arises, because the driver is assumed to be always in charge and command within the framework of human-centered automation (Inagaki 2006).

The author has been investigating the issue of authority and responsibility between the driver and the automation to show that the automation may be allowed to trade authority from the human to the automation based on its decision for assuring safety of automobile (Inagaki 2003, 2010; Inagaki & Sheridan 2012; Inagaki, Itoh & Nagai 2008).

When the assistance system is capable to correct and prevent ‘erroneous’ behavior of the driver, overtrust in and overreliance on the assistance become an important issue: Regulatory authorities often express their concerns over the possibility of the drivers’ behavioral changes in which they place excessive trust in and reliance on the driver assistance systems. The author has been investigating trust and reliance related issues and has given recently a theoretical framework for discussing the driver’s overtrust in and overreliance on autonomous assistance systems in a rigorous manner (Inagaki & Itoh 2013).

References
Billings CE (1997) Aviation automation – the search for a human-centered approach. LEA, Mahwah

