ABSTRACT

As applications in service robots grow, there is a need to provide guidance appropriate to this emerging sector in relation to safe human-robot interaction. Existing guidelines for robots have been developed for industrial applications where the general philosophy is to separate the robots from humans and risk assessment for manufacturers is based on guidelines in ISO 13849-1 [1] which define severity of harm, frequency of occurrence and possibility of avoidance harm each into two levels to determine the safety performance level required for any robot system.

In this presentation we argue that the risk assessment criteria used for industrial applications is inadequate for service robots. For example in recent studies we have carried out a risk assessment on the emergency stop function of two types of person carrier robot (indoor and outdoor) using both the risk graph methodology in ISO 13849-1 and the Abbreviated injury scale (AIS) [2]. While it was possible to identify that these two examples had different severity levels using the AIS, the ISO risk graph method failed to distinguish between the two. This suggests that new schemes for risk assessment for personal care robots are necessary.

We argue that there are several factors that must be included in the risk assessment of personal care robots.

1) **Injury severity** should account for the level of medical care required for the injury as well the number of injuries caused by any single hazard event and should be comprehensive covering all levels of foreseeable severity.

2) **Frequency of occurrence and Probability of avoidance** must consider the user type (adult, child, elderly person, etc) and must be aligned with existing safety assurance requirements.

We propose a new scheme integrating these factors into one set of risk criteria and provide robot risk assessment examples to illustrate.

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