IFA
Institut für Arbeitsschutz der
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Focus on IFA's work

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Occupational safety at workplaces involving collaborative robots

Problem

During revision and restructuring of the standards governing industrial robots, a further new area of application was created, that of collaborative robots. Collaborative robots are employed at new forms of workplace in which constrained working spaces are shared by robots and human beings and in which guards cannot be used in order to rule out collision risks completely. Collision must be prevented as far as possible by safe control of the robot and by sensors for the detection of relevant movements by the robot and the human being at the workplace application. A small probability of collision nevertheless remains. The mechanical hazards presented by colliding robot parts (scale of damage) must therefore be reduced to such a level that affected persons are exposed only to an acceptable residual risk.

Since the newly developed standards contain no satisfactory criteria or values for limiting the consequences of a collision should it occur, a research project was to be conducted by the institute in order to develop supplementary and detailed requirements for risk reduction. These requirements were to be made available in the form of BG/BGIA Recommendations for use in practice. The research project was launched by the expert committee responsible for machine construction, production systems and steel construction.

Fitting of a dashboard; image: Daimler AG

Activities

Based upon existing data from the scientific literature and the OSH regulations in force in the area covered by the German accident insurance institutions (such as established limit values for automatic shutters, doors and gates), a pilot study was able to provide broad answers to the essential questions. Documented injuries/medical studies and the mechanical stresses causing them were analysed. The focus lay upon: permissible clamping and squeezing forces, impact forces, surface pressure, and data on the deformability of relevant body regions. The quality of the data surveyed was checked against preliminary measurements conducted for the purpose. Together with the BG expert committee responsible for machine construction, production systems and steel construction, the IFA laid down

certain parameters which were used to derive limit values for force and pressure and other design variables for potential collision areas of the robot based upon the surveyed injury data. The refined data were compiled and assigned to a simplified body model with four main body regions and 15 specific body regions.

Results and Application

The result of the pilot study are BG/BGIA Recommendations which enable manufacturers and operators of collaborative robots to conduct a precise analysis of mechanical hazards at workplaces which involve the use of such robots. In these recommendations, a permissible mechanical stress in the event of a collision is defined as being such that impermissible strain upon the persons cannot occur. The BG/BGIA Recommendations present a simplified body model, with differentiation by body region and medical/biomechanical requirements involving limit values for a range of stress cases, together with further technological, ergonomic and work organizational requirements. The BG/BGIA Recommendations also provide information on verification measurements of the limit values, and contain a checklist for the procedure forming part of risk assessment in plant practice. Parallel to the research work, the content of the document was agreed with a team of experts which included manufacturers and users.

Workplaces involving collaborative robots can now be designed such that the essential health and safety requirements for the employees in companies are assured.

Area of Application

Enterprises and organizations which manufacture or use collaborative robots. Future uses may exist in the area of service robotics (in the welfare and healthcare sectors). The requirements of the BG/BGIA Recommendations can also be transferred to the entire machine construction sector where similar technical issues arise. The BG/BGIA Recommendations are also able to provide important information for research projects addressing similar medical/biomechanical issues.

Additional Information

- BG/BGIA recommendations Design of workplaces with collaborative robots (U 001/2009e). Published by: BGIA – Institut für Arbeitsschutz, Sankt Augustin 2009
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- Ottersbach, H. J.; Umbreit, M.: Occupational Safety in Workplaces with Collaborative Robots. Technical discussion about machine protection on 5 & 6 May 2009 at the BGIA.
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- Ottersbach, H. J.: Aspects for working out an acceptable injury risk in workplaces with collaborative robots from the point of view of the institutions for statutory accident insurance and prevention. Workshop on 31 August 2007 in Lengfurt – BG Metall Nord Süd “What can, may and should collaborative robots do?”.
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Expert Assistance

IFA, Division 5: Accident Prevention – Product Safety

Literature Requests

IFA, Central Division

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