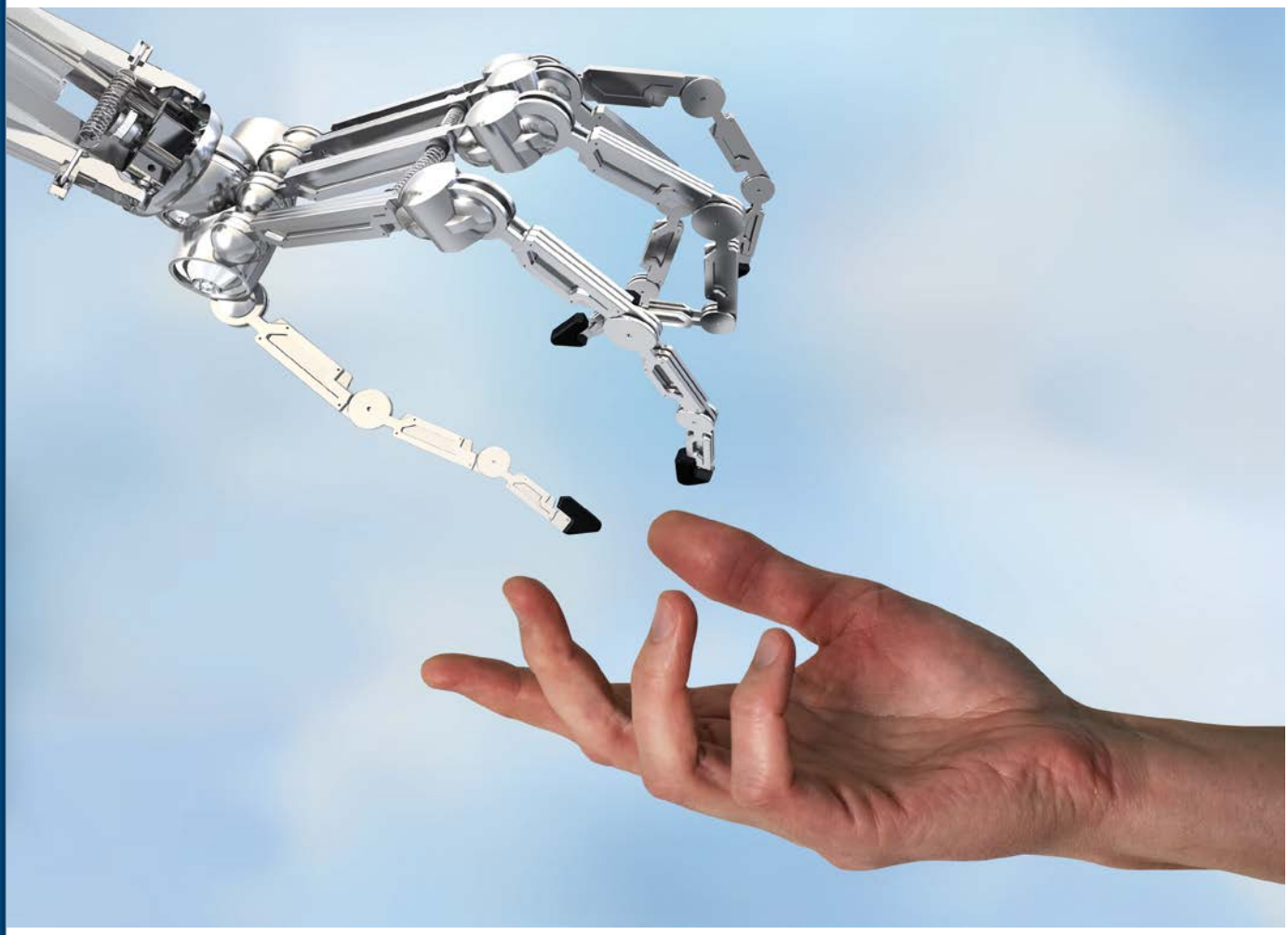
OMRON
AUTOMATION & SAFETY

Collaborative Robots

Power and Force



Safe Applications

- Description
- Definitions
- Guidelines
- Design

"Human error is not a potential, it is a given."

Description

In a power and force application, the operator and collaborative robot may work in the collaborative workspace concurrently. There is a possibility of contact between the collaborative robot system, including the end effector and workpiece, and the operator.

Information can be found in the Industrial Robots and Robot Systems – Safety Requirements standard, ANSI RIA R15.06-2012, which is harmonized with ISO 10218-1:2011 and ISO 10218-2:2011.

Detailed collaborative safety requirements will be available in the ISO/TS 15066 Technical Specification, which is expected to be available in late 2015 or early 2016.

Definitions

Collaborative Workspace

It is the space within the operating space where the robot system and a human can perform tasks concurrently.

Collaborative Operation

The purposely designed robot system and operator work within a collaborative workspace.

Quasi-static contact

When contact can cause a body part(s) to be clamped.

Transient contact

When contact does not causing clamping condition and the operator has the possibility to retract.

Safety-Rated Monitored Stop

The robot/collaborative robot stops before the operator enters the collaborative workspace.

With a traditional robot this may be achieved with a safety-rated control system that complies with the requirements in ANSI/RIA 15.06-2012.

With a collaborative robot this may be achieved through inherently-safe design.

Safety-Rated Space Limiting

A limit is placed on the robot's range of motion by a software or firmware based system having a sufficient safety-rated performance.

Guidelines for All Systems

These guidelines are applicable for collaborative robot systems. Detailed information can be found in the ISO/TS 15066 technical specification.

- The collaborative robot is required to have a safety-rated monitored speed function and safety-rated monitored stop function.
- The maximum number of people allowed in the collaborative space is stated in the Information for Use.
- If the operator's safety is dependent on limiting the robot's range of motion, the application can use the robot's safety-rated soft axis and space limiting functions or other external safety-rated system.
- The robot is allowed to be moving when the operator enters the collaborative workspace.
- The collaborative workspace is defined as any area where the robot can move. In many cases this will be the same as the robot's defined workspace (including the end-effector and part).
- If an operator enters the collaborative workspace while the robot is moving, the robot shall maintain a safe speed as determined by calculations and charts found in ISO/TR 15006.
- If operator safety is dependent on the movement or location of the robot, the robot shall have a way to knowing its position.

Design

Some design consideration may include:

- The entire space needs to be included in the risk assessment, including hazards from other equipment, end effectors and fixtures, etc.
- Determine what happens if failures from parts of the control system other than the collaborative robot occur, and additional safeguarding required to enable a protective stop.
- If quasit-static contact is possible, what means are available so the operator can be released? Consider the amount of time contact is allowed and the exerted force during this time.
- The system shall be designed so the collaborative robot, end-effector and/or workpiece never come into contact with the operator's head and neck.
- Clearly define the areas where the operator may be located.
- Define how many operators are allowed in the collaborative workspace and the collaborative robot's protective stop conditions when this value is exceeded.
- Verify the operator is able to clearly see within the entire collaborative operation area.
- Conditions when quasi-static and transient contact could be mixed.

Design (Continued)

- The TCP (tool center point) is needed to calculate the safe speed.
- The effects of PPE (personal protective equipment): Does it create entanglement, affect feedback signals during contact, alter operator's ability to shift position or to leave the area easily, etc.
- Are there sharp edges that could be mitigated by using rounded edges/corners, smooth surfaces, compliant surfaces, padding, cushioning, compliant joints, etc.
- What unexpected conditions may occur that may affect the operator's position or responsiveness, such as distractions, posture change due to drowsiness, dropped parts, quick reactions due to loud noise, etc.
- If contact is made and the collaborative robot goes into a protective stop, under what conditions would the system be reset manually and when could it be done automatically.
- How the part size and shape variations can affect the collaborative robot's speed and mass.
- The worst case scenario is used to determine the maximum speed allowed. Included in the calculations may be factors such as the collaborative robot arm, link speeds, mass distributions, contact locations, poses, etc.
- Where possible contact between all parts of the collaborative robot's system and the operator can occur.
- The amount of pressure for each type of contact.
- What part of the operator's body the collaborative robot system could be in contact with.
- The effects of repeated contact.

Collaborative Robot Guidelines

Most collaborative robots are inherently safe by their design. This may include features such as force amplification, virtual safety zones, and tracking technologies. This guideline may not be applicable for traditional industrial robots

The transient contact chart in the annex of ISO/TR 15066 should be used to determine robot's maximum speed.

ISO 13855 should be used to establish the safe distance.

Note: Each application is unique and may include topics not listed.

OMRON
AUTOMATION & SAFETY

Would you like to know more?

Omron Automation and Safety
800-556-6766
www.omron247.com

Stay in touch

twitter.com/OmronProduct
youtube.com/user/OmronAutomationTech
linkedin.com/company/omron-electronics

OMRON AUTOMATION AND SAFETY • THE AMERICAS HEADQUARTERS • Chicago, IL USA • 847.843.7900 • 800.556.6766 • www.omron247.com

OMRON CANADA, INC. • HEAD OFFICE
Toronto, ON, Canada • 416.286.6465 • 866.986.6766 • www.omron247.com

OMRON ELECTRONICS DE MEXICO • HEAD OFFICE
México DF • 52.55.59.01.43.00 • 01-800-226-6766 • mela@omron.com

OMRON ELECTRONICS DE MEXICO • SALES OFFICE
Apodaca, N.L. • 52.81.11.56.99.20 • 01-800-226-6766 • mela@omron.com

OMRON ELETRÔNICA DO BRASIL LTDA • HEAD OFFICE
São Paulo, SP, Brasil • 55.11.2101.6300 • www.omron.com.br

OMRON ARGENTINA • SALES OFFICE
Cono Sur • 54.11.4783.5300

OMRON CHILE • SALES OFFICE
Santiago • 56.9.9917.3920

OTHER OMRON LATIN AMERICA SALES
54.11.4783.5300

OMRON EUROPE B.V. • Wegalaan 67-69, NL-2132 JD, Hoofddorp, The Netherlands. • +31 (0) 23 568 13 00 • www.industrial.omron.eu

R82I-E-01

Note: Specifications are subject to change

Printed in U.S.A.

Printed on recycled paper.