COLLABORATIVE WELDER ROBOT FLEXIBLE SAFETY ZONES DETERMINATION

1Abdallah Kafi ,  
1 Öbuda University, Doctoral School on Safety and Security Sciences  
abdallahkafi1994@gmail.com

2Tünde Anna Kovács  
2 Öbuda University, Bánki Donát Mechanical and Safety Engineering, Hungary  
kovacs.tunde@uni-obuda.hu

Introduction
Welding is a very important part of industrial works. Unfortunately, the gas metal arc welding (GMAW) establish some unhealthy effects, like smoke, UV light radiation, spattering and heat. These effects cause different health damages. In this research, the authors focus on the UV heath effect and want to determine a flexible safety zone on the base of the limit of the unhealthy UV radiation level. The collaborative robots are working now behind walls, but the walls hinder their movement between the workplaces. When the goal is to tear down the walls and do the moving of the collaborative robots faster, it needs to install virtual walls to assure the human workers’ safety.

During the GMAW the UV radiation level depends on the used power and the used shielding gas. The authors wanted the determine a flexible safety zone as a function of the welding parameters focused on the gas chemical composition and the power.

Welding workplace risk assessment
Welding risks of GMAW  
• UV light (direct and reflected)  
• Smoke  
• Spattering  
• Heat

Collaborative robot
Forbidden to cause any human health damage  
• Moving between workplaces  
• Working with human workers

Without a safety fence!

Flexible risk zone determination
1. Danger zone: the diameter of the danger zone calculated from the robot maximal arm reach, the safe light distance + safety coefficient.

2. Alarm zone: the diameter of the alarm zone calculated from the diameter of the danger zone and the average human walking speed, the reaction time + safety coefficient.

3. Extended zone: the diameter of the extended zone calculated from the diameter of alarm zone diameter + safety coefficient.

Risk zones of the collaborative welder robot

UV risk
- Radiation intensity (depends on the distance from the UV source)  
- Exposition time (time of exposure to radiation)

Conclusion
1. Danger zone can determine by the most dangerous effect (UV) of the welding in the case of GMAW.
2. Unhealth UV level needs to be the base of the danger zone determination.
3. Safety assure by the determination of the flexible danger zone diameter from the welding parameters in the case of GMAW.

Acknowledgement
We acknowledge the technical support of this work by the Linde Gas Hungary Zrt