Simulation of Robotized Mig Welding Using Robotstudio

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Abstract: ***Simulation of a robotized operation before actual operations in a production line is a valuable tool for industry. This work uses RobotStudio software for carrying out the simulation of a robotized MIG welding operation on a tractor component. The simulation of the operation helps in the verification of the robot program which can be subsequently downloaded to the actual ABB robot controller. Moreover, the process time for the operation can be optimized by changing appropriate parameters of the robot like robot speed and zone settings. Simulation and process time optimization of the robotized MIG welding in the virtual environment results in reduction of program development and process lead times. Collision detection and identification of problems before hand can also summarily be highlighted through simulation study.***

Keyords: RobotStudio, Virtual Environment, Process Time, Simulation

1. Introduction

Research in welding simulation can be divided into two main fields, namely robot simulation, often referred to as CAR (Computer Aided Robotics), and thermal-mechanical modeling. CAR is concerned with simulation and programming of a robot task using a virtual model of the workcell and the part to be welded. Examples of research in this area are the integration and development of virtual sensors and the optimization of welding sequences and torch trajectories to avoid collisions and to increase productivity. The industrial interest in manufacturing simulation tools has increased significantly in recent years, which is why simulation has become an increasingly common tool to test and verify different approaches prior to manufacturing. A simulation tool such as one described in the current work would therefore be of great benefit to the industry. Such a simulation tool would reduce both the number of welding experiments and the need for welding operator experience. The tool should preferably be able to simulate the welding torch path, be capable of detecting collisions between the torch and workpiece.

2. Literature Review

Gasparetto et al (2007) described a new method for smooth trajectory planning of robot manipulators [10]. In order to ensure that the resulting trajectory is smooth enough, an objective function containing a term proportional to the integral of the squared jerk (defined as the derivative of the acceleration) along the trajectory was considered. Ganjigatti et al (2007) made an attempt to establish input–output relationships in MIG welding process through regression analyses carried out both globally (i.e., one set of response equations for the entire range of the variables) as well as cluster-wise [9]. Kim et al (2004) described Robotic gas metal arc (GMA) welding as a manufacturing process which is used to produce high quality joints and has a capability to be utilized in automation systems to enhance productivity [14]. Kim et al (2003) discussed the robotic arc welding process which involves sophisticated sensing and control techniques applied to various process variables [15]. Tung Pi-Cheng et al (2004) briefed that conventionally shield metal arc welding (SMAW) has been performed by manual operator, and hence it is not easy to apply in hazardous areas such as in nuclear power plants [26]. Kim et al (2002) described the development of an intelligent algorithm to understand relationships between process parameters and bead height, and to predict process parameters on bead height through a neural network and multiple regression methods for robotic multi-pass welding process [16]. Benyounis et al (2007) showed Welding input parameters play a very significant role in determining the quality of a weld joint. The joint quality can be defined in terms of properties such as weld-bead geometry, mechanical properties, and distortion [4]. Karadeniz et al (2007) studied the effects of various welding parameters on welding penetration in Erdemir 6842 steel having 2.5 mm thickness welded by robotic gas metal arc welding were investigated [13]. Ates Hakan (2007) presented a novel technique based on artificial neural networks (ANNs) for prediction of gas metal arc welding parameters [2]. Sharma Rajashekhar S. et al (2009) discussed that advanced high strength steels (AHSS) are essential to meet the demands of safety and fuel efficiency in vehicles [25].Kanti K. Manikya et al (2008) presented the development of a back propagation neural network model for the prediction of weld bead geometry in pulsed gas metal arc welding process [12].Pal Sukhomay et al (2008) addressed that the weld joint strength monitoring in pulsed metal inert gas welding (PMIGW) process. Response surface methodology was applied to perform welding experiments [21]. Palani P.K. et al (2006) found that Pulsed welding is a controlled method of spray transfer, in which the arc current is maintained at a value high enough to permit spray transfer and for long enough to initiate detachment of a molten droplet [20]. Akula Sreenath babu et al (2006) described a direct metal rapid tool making process, hybrid-layered manufacturing (HLM), which was developed for building metallic dies and molds. [1] This unique methodology had a numerical controlled system that integrates the Trans Pulse Synergic Metal Inert Gas (MIG)/ Metal Active Gas (MAG) welding process for near-net layer deposition and Computer Numerical Control (CNC) milling process for net shaping. Dubourg et al (2010) focused on the results of process optimisation and mechanical tests that were used to ascertain the feasibility of using friction stir welding (FSW) to join stringers to skin [6]. Ma Hongbo et al (2010) proposed a kind of mixed logical dynamical (MLD) model to predict the back bead width of pulsed GTAW process with misalignment [17]. Palani P.K. et al (2007) found that the quality of cladded components depends on the weld bead geometry, coefficients of shape of welds and dilution, which have to be controlled [19]. Huang Jiankang et al (2010) established a rapid prototyping control platform using the xPC real-time target environment based on the sliding mode control theory according to the stability problem of wire extension in aluminum alloy pulsed MIG welding, and then the real-time control on wire extension in aluminum alloy pulsed MIG welding was carried out with sliding mode controller [11]. Ohshima K et al (2002) proposed a digital computer control system for improving the stability of the torch position and weld pool shape in metal inert gas (MIG) welding [18].

3. Robotized MIG Welding

Gas Metal Arc Welding (GMAW) is frequently referred to as MIG welding. It is a commonly used, high deposition rate welding process. The MIG welding process involves feeding a wire continuously toward the heated weld tip. It is considered a semi-automatic welding process. Fully automating MIG welding offers many advantages. The benefits of Robotized MIG Welding are:

- The systems are capable of all-position.
- Have higher deposit rates than SMAW.
- Need less operator skill.
- Perform longer welds without stopping.
- Require minimal post weld cleaning.
- Produce high quality welds.
- Return on investment (ROI) occurs after only a few years.
- Robotized MIG welding will increase productivity, throughput, and revenue.

4. RobotStudio

RobotStudio is a highly advanced simulation and off-line programming software with a number of outstanding features and benefits. Some of these features are:

- 3D-simulation environment - full 3D representation of robotics system
- Virtual Controller - the real robot controller embedded in your PC
- Robot Library - exact models of the entire ABB robot product line
- Virtual Teach Pendant -perfect for training operators off-line
- RAPID Program Editor - automatic program error checking
- I/O Simulator - interact with simulated inputs/outputs
- Visual Basic for Applications - develop your own functionality

Functionality of the software includes:

- Creation of motion path
- Cycle time estimation and optimization
- Programming and validation of complete production programs
- Collision detection and visualization
- Feasibility studies and reachability tests
- Easy evaluation of standard components

5. Simulation using RobotStudio

In this paper, the fabrication of a component of of a tractor i.e. the axle cover has been simulated using RobotStudio software (version 5.12 school edition). This component is being fabricated by a vendor of Sonalika Tractors Ltd. Robotized MIG welding operation is being used for the fabrication of integral axle cover of the tractor. The component is tack welded at some points and then it is welded continuously along a predefined path using an ABB robot. For this first of all a CAD model of the component was made. The CAD model can be made by using any CAD software like CATIA or Pro-E. The CAD model of the component was developed in Iges format (wrl or stl can also be used). The CAD format should preferably be in iges format. But wrl and stl formats could also be used. After the component was made on CAD software, it was imported in RobotStudio. The component was imported into the RobotStudio workcell and moved to desired position. Then path of the MIG welding process was selected by choosing a number of points on the component. The simulation after completion was run by using move along the path command. By enabling the process timer on, the process time was calculated. Programming of the robot along the desired path takes time for a complex part such as axle cover. To save the time for programming, the simulation has been done using RobotStudio software. The program generated from simulation was uploaded from the virtual controller to the real ABB controller. In this way, the time required for programming the robot has been saved.

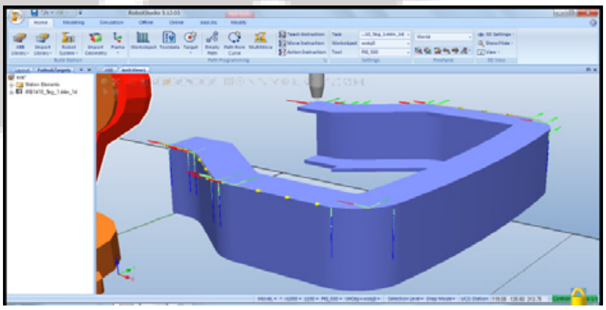

Figure 1: CAD model of the tractor component

Figure 2: Robotized MIG welding workcell

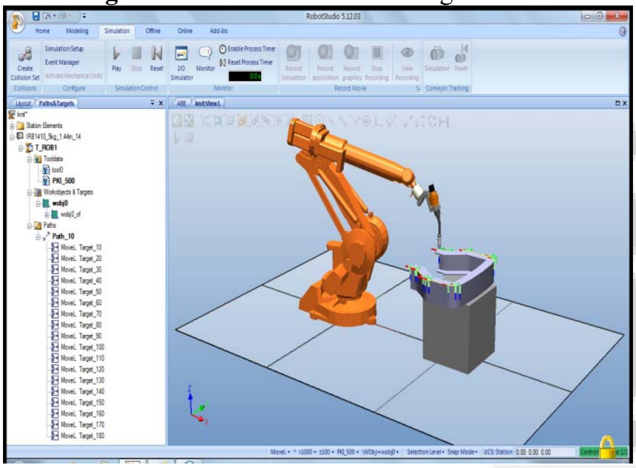

Figure 3: Target points of the path generated during simulation.

6. Conclusion

In this work, RobotStudio has been used for the simulation of a robotized MIG welding operation. Simulation has been done for a tractor component. By doing the simulation the time for programming has been saved. Further any collisions between the robot and parts (and fixtures) in the workcell is avoided. The developed program can be loaded to the controller from the RobotStudio virtual controller for carrying out the actual operation. The optimal program generated from simulation is given as Annexure 1. The following figures show some of the results achieved during simulation. Figure 1 shows the CAD model of the axle cover of the tractor component imported in the RobotStudio. It was imported as stl or wrl format. Figure 2 shows the robotized MIG welding work cell generated in the RobotStudio. Work cell includes a robot (model IRB 1410_5kg_1.44m_5), welding gun (model PKI_500), a table or fixture and the component (ie axle cover) itself. Figure 3 shows the path and the target points of the generated path during simulation. Along these target points or path, the robot moves along after simulation and program is generated accordingly.

Table 1: Variation of velocity/zone with process time

Process Time 'T'(sec)						
Z (mm) / V (mm/s)	Z=fine	Z=0	Z=10	Z=20	Z=50	Z=100
V=10	151.2	149.8	149.1	148.4	148.2	148.2
V=20	76.4	75.1	74.6	74.3	74.2	74.2
V=30	51.4	50.1	49.7	49.5	49.4	49.4
V=40	39.6	38.4	38.0	37.8	37.8	37.7
V=50	31.7	30.5	30.0	29.9	29.9	29.9
V=60	27.5	26.2	25.7	25.6	25.6	25.6

The process time is a function of various parameters viz. velocity, acceleration, ramp and zone. Here the variable could be velocity and zone available till date on this software. Velocity and zone can be varied by selecting the moveL points in path tree and on selecting modify instruction command, these parameters could be changed. Correspondingly, the process time for each variation was measured by enabling the process timer. The data generated is shown in the table 1.

This clearly shows that as velocity of welding increases, process time decreases as expected without relevance to zone. Moreover, for velocity range of 10-20 mm/s, the process time increases at a very steep rate. Where as, the process time varies almost linearly for velocity range of 30-60 mm/s. Besides this, for finer zone settings, process time increases for a particular velocity. The velocity changes for finer zone settings bring very steep changes in process times. For example, for fine zone at a speed of 10 mm/s, the process time is 151.2 sec. But for zone setting 100 at same velocity (10 mm/s), the process time is 148.2 sec. This clearly shows that time increases steeply for finer zone settings for any particular speed setting. But for coarser zone settings (for 50 or 100), the process time almost remains constant. Figure 4 shows the line chart for the variation of velocity and zone settings with respect to the process time.

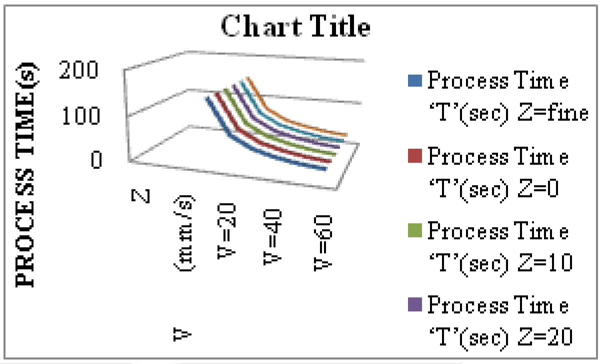

Figure 4: Line chart for variation of velocity/zone with process time

7. Scope for Future Work

In this work the simulation of a tractor component has been done on simulation software named RobotStudio. By doing the simulation the time for programming has been saved as the program can be loaded to the controller from the RobotStudio virtual controller. Secondly, velocity of the robot arm has been optimized. In present work, the other important parameters like weld penetration, stresses during welding and other welding effects have not been considered. These parameters are very important regarding the quality aspects of the welding. By taking care of these parameters, the present work could be made more comprehensive and fruitful not only for optimization of process time but also take care of the quality aspect as well.

References

[1] Akula Sreenathbabu, Karunakaran K.P., Hybrid adaptive layer manufacturing: An Intelligent art of direct metal rapid tooling process, Robotics and Computer-Integrated Manufacturing, Vol.22, pp 113–123, 2006.
[2] Ates Hakan, Prediction of gas metal arc welding parameters based on artificial neural networks, Materials and Design, Vol. 28, pp 2015–2023, 2007.
[3] Barnes T.A., Pashby I.R., Joining techniques for aluminium spaceframes used in automobiles Part I D solid and liquid phase welding, Journal of Materials Processing Technology, Vol. 99, pp 62-71, 2000.
[4] Benyounis K.Y., Olabi A.G. Optimization of different welding processes using statistical and numerical approaches – A reference guide (2007), Advances in Engineering Software, Vol. 39, pp 483–496, 2008.
[5] Bolmsjo Gunnar, Olsson Magnus and Cederberg Per, Robotic arc welding – trends and developments for higher autonomy, Industrial Robot: An International Journal, Volume 29 , Number 2, pp 98–104, 2002.
[6] Dubourg L., Merati A., Jahazi M., Process optimisation and mechanical properties of friction stir lap welds of 7075-T6 stringers on 2024-T3 skin, Materials and Design, Vol 31, pp 3324–3330, 2010.
[7] Eguchi, K. Yamane, S. Horinaka, S. Kubota, T. Oshima, K., Sensing of groove gap and torch position using neural network in pulsed MIG welding, Industrial Electronics, Control and Instrumentation, Vol. 3, pp 1409, Print ISBN: 0-7803-3932-0, 2002.
[8] Ericsson M. and Nylen P., A Look at the Optimization of Robot Welding Speed Based on Process Modeling, Welding Journal, Vol. 86, pp 238s-244s, 2007.
[9] Ganjigatti J.P., Pratihar Dilip Kumar, Choudhury A. Roy, Global versus cluster-wise regression analyses for prediction of bead geometry in MIG welding process,Journal of Materials Processing Technology, Vol. 189, pp 352–366, 2007.
[10] Gasparetto A., Zanotto V., A new method for smooth trajectory planning of robot manipulators, Mechanism and Machine Theory, Vol.42, pp 455–471, 2007.
[11] Huang Jiankang, Lihui Ding Fan, Shi Lu Yu, Wen Junxia, Wire extension sliding model control based on rapid prototyping in aluminum alloy pulsed MIG welding, Intelligent Control and Automation (WCICA), pp 2482, Print ISBN: 978-1-4244-6712-9, 2010.
[12] Kanti K. Manikya, Rao P. Srinivasa, Prediction of bead geometry in pulsed GMA welding using back propagation neural network, Journal of materials processing technology, Vol. 200, pp 300–305, 2008.
[13] Karadeniz Erdal , Ozsarac Ugur, Yildiz Ceyhan, The effect of process parameters on penetration in gas metal arc welding processes, Materials and Design, Vol. 28, pp 649–656, 2007.
[14] Kim Ill, Son Joon-Sik, Lee Sang-Heon, Yarlagaddaca Prasad K.D.V., Optimal design of neural networks for control in robotic arc welding, Robotics and Computer-Integrated Manufacturing, Vol. 20, pp 57–63, 2004.
[15] Kim I.S., Son J.S., Kim I.G., Kim J.Y., Kim O.S., A study on relationship between process variables and bead penetration for robotic CO2 arc welding, Journal of Materials Processing Technology, Vol. 136, pp 139–145, 2003.
[16] Kim I.S., Son J.S., Park C.E., Lee C.W., Yarlagadda Prasad K.D.V., A study on prediction of bead height in robotic arc welding using a neural network, Journal of Materials Processing Technology, Vol. 130–131, pp 229–234, 2002.
[17] Ma Hongbo, Wei Shanchun, Lin Tao, Chen Shanben, Mixed logical dynamical model for back bead width prediction of pulsed GTAW process with misalignment, Journal of Materials Processing Technology, Vol. 210, pp 2036–2044, 2010.
[18] Ohshima, Yamamoto K., Tanii M., Yamane T.S. Digital control of torch position and weld pool in MIG welding using image processing device, Industry Applications, IEEE Transactions, Vol. 28, Issue 3, pp 607,ISSN : 0093-9994, (2002).
[19] Palani P.K., Murugan N., Optimization of weld bead geometry for stainless steel claddings deposited by FCAW, Journal of Materials Processing Technology, Vol. 190, pp 291–299, 2007.
[20] Palani P.K., Murugan N., Selection of parameters of pulsed current gas metal arc welding, Journal of Materials Processing Technology, Vol. 172, pp 1–10, 2006.
[21] Pal Sukhomay, Pal Surjya K. , Samantaray Arun K., Artificial neural network modeling of weld joint strength prediction of a pulsed metal inert gas welding process using arc signals, Journal of materials processing technology, Vol. 202, pp 464–474, 2008.
[22] Pires Nuberto J., Godinho T., Ferreira P., CAD interface for automatic robot welding programming, Industrial Robot: An International Journal, Vol. 31, Number 1, pp 71-76, 2004.
[23] Pires Norberto, Loureiro J., Godinho A., Ferreira T., Fernando P., Morgado B.J., Welding robots, Robotics & Automation Magazine, IEEE, Vol.10 , Issue 2 , pp 45, 2003.
[24] Rolfe A.C., A perspective on fusion relevant remote handling techniques, Fusion Engineering and Design, Vol.82, pp 1917–1923, 2007.
[25] Sharma Rajashekhar S., Molian Pal, Yb:YAG laser welding of TRIP780 steel with dual phase and mild steels for use in tailor welded blanks, Materials and Design, Vol. 30, pp 4146–4155, 2009.
[26] Tung Pi-Cheng, Wu Ming-Chang, Hwang Yean-Ren, An image-guided mobile robotic welding system for SMAW repair processes, International Journal of Machine Tools & Manufacture, Vol. 44, pp 1223–1233, 2004.
[27] Yamamoto, Kaneko M., Fujii Y., Kumazawa K., Ohshima T., Alzamora K., Kubota G., Ozaki T., Anzai F. S. Adaptive control of pulsed MIG welding using image processing systems, Industry Applications Society Annual Meeting, IEEE , pp 1381, 2002.
[28] Zhang Qingle Pang Min, Design of digital control system for pulsed MIG welding power source, Intelligent Control and Automation (WCICA), pp 2492, Print ISBN: 978-1-4244-6712-9, 2010.

Author Profile

Rohit Sharma received the B.Tech. degree in Mechanical Engineering from Beant College of Engineering and Technology, Gurdaspur in 2001 and M.E. degree in Production Engineering from PEC University of Technology, Chandigarh in 2011 respectively. He had worked as a lecturer in Industrial and Production Engineering department and as Assistant Professor in Mechanical Engineering department of Dr B R Ambedkar NIT, Jalandhar. He has 5 years of industry experience and 4 years of teaching experience. At present he is a research scholar in Industrial and Production Engineering department of Dr B R Ambedkar NIT, Jalandhar since July' 2012.

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Dr Ajay Gupta is working as a Associate Professor in Industrial and Production Engineering department of Dr B R Ambedkar NIT, Jalandhar. He has done B.Tech, M. Tech and PhD (Industrial Engg) in the years 1993, 2006 and 2012 respectively from Dr B R Ambedkar NIT, Jalandhar. He did his M.B.A from IGNOU, New Delhi in 2001. He has 19 years of teaching and 2 years of industry experience. He is Ex – Deputy Registrar (A/Cs), Dr B R Ambedkar NIT, Jalandhar. At present he is also Nodal officer (Procurement) TEQIP-II Dr B R Ambedkar NIT, Jalandhar.

Annexure 1
Program Developed

```
MODULEModule1
CONSTrobtargetTarget_10:=[[787.98046875,-
250.551116943359,530.058959960938],[-
8.32667268468867E-16,-8.04911692853238E-16,1,-
5.23852944873329E-32],[-1,0,-
1,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
CONSTrobtargetTarget_20:=[[831.896484375,-
253.224945068359,529.022094726563],[-
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1,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
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1,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
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5.23852944873329E-32],[-1,0,-
1,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
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1,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
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8.32667268468867E-16,-8.04911692853238E-16,1,-
5.23852944873329E-32],[-1,0,-
1,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
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328.566253662109,530.880493164063],[-
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1,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
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16,-8.04911692853238E-16,1,-5.23852944873329E-
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1,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];

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PROCmain()
ENDPROC
PROCPath_10()
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 MoveLTarget_160,v60,z100,PKI_500\WObj:=wobj0;
 MoveLTarget_170,v60,z100,PKI_500\WObj:=wobj0;
 MoveLTarget_180,v60,z100,PKI_500\WObj:=wobj0;
ENDPROC

ENDMODULE
```