A Novel Defect Classification Scheme Based on Convolutional Autoencoder with Skip Connection in Semiconductor Manufacturing

Jaegyeong Cha*, Juyong Park*, Jongpil Jeong*

*Department of Smart Factory Convergence, Sungkyunkwan University, Suwon, Republic of Korea

sean9887@naver.com, wndyddl777@naver.com, jpjeong@skku.edu

Abstract— The semiconductor process cannot avoid defects due to its complex and diverse processes. In particular, wafer can be said to be the core of semiconductor manufacturing because they are directly related to the productivity of semiconductors. Therefore, detecting and classifying defects on wafers can help engineers address the root cause of defects and improve yield. In this paper, we propose a convolutional autoencoder using skip connection for wafer map defect classification. First, the encoder and decoder are designed by constructing a convolutional block. And connect the symmetrical blocks with skip connection. Finally, the training data of the classifier is encoded using the weights of the learned encoder. The loss of the model was successfully reduced with skip connection, and improved performance was obtained by reusing the encoder.

Keyword—wafer, convolutional autoencoder, skip connection, semiconductor

JAEGYEONG CHA received the B.S. degree in Nanomechatronics Engineering from Pusan National University, Korea. He is currently pursuing the master's degree in the Department of Smartfactory Convergence, Sungkyunkwan University, Suwon, Korea. His research interests include semiconductor manufacturing, deep learning, machine learning and smartfactory.

JUYONG PARK received the B.S. degree in Electronics and Communications Engineering from Kwangwoon University, Korea. He is currently pursuing the master's degree in the Department of Smartfactory Convergence, Sungkyunkwan University, Suwon, Korea. His research interests include semiconductor manufacturing, deep learning, machine learning and smartfactory.

JONGPIL JEONG received his B.S. degree in engineering from Sungkyunkwan University and the M.S. and Ph.D. degrees in computer engineering from Sungkyunkwan University, Suwon, Korea, in 2003 and 2008, respectively. He was a Research Professor with Sungkyunkwan University in 2008-2009 and 2011, and a visiting professor with the Department of Interaction Science (WCU Program) in Sungkyunkwan University in 2009-2010. He started his academic profession at the Research & Business Foundation of Sungkyunkwan University, Korea in 2012 as an assistant professor. And now he is a PI and Professor of Department of Smart Factory Convergence. He received twice Excellent Research Awards from Department of Electrical and Computer Engineering, Sungkyunkwan University, Korea (2007), from KSII (Korea Society for Internet Information), Korea (2011), from IIBC (2013, 2014, 2016, 2017), from KIPS (2014, 2017), and from others. His research interests include 4th Industrial Revolution, Smart Factory, Smart Manufacturing, Digital Twin, AI, 5G, Mobile Computing, Mobility Management for IoT Applications and Networks, Interaction Science, Sensor Networking, Protocol Operation based Performance Analysis, Internet Security, MIPv6 and Ubiquitous Computing. He is the 4 patents and 200 international publications in refereed journals and conferences. He is a member of ACM, IEEE, KIPS, IIBC, and member of many international program committees. He has organized many conferences, chaired several technical sessions and gave tutorials at major international conferences. Recently, he is the workshop chair of SFC 2018-2019 (Smart Factory Convergence), and SMSM 2018-2019 (Smart Manufacturing and Smart Molility).