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COLLABORATIVE MANAGEMENT OF INDUSTRIAL ROBOT APPLICATIONS AND CIRCULAR ECONOMY STRATEGY: SPATIOTEMPORAL EVOLUTION AND REGIONAL DIFFERENCES

Xin Zhao[1,2], Xiaohu Yu[1], Mohammad Zoynul Abedin[3], Yuping Shang[4*]

[1]*School of Statistics and Applied Mathematics, Anhui University of Finance and Economics, Bengbu, China*
[2]*Advanced Research Centre, European University of Lefke, Lefke, Northern Cyprus, TR-10 Mersin, Turkey*
[3]*Department of Accounting and Finance, School of Management, Swansea University, UK.*
[4]*School of Economics, Hefei University of Technology, Hefei, 230009, China*

Abstract

As the global economy rapidly evolves, the need for economic recycling has intensified, and the optimization of industrial robot applications encounters unprecedented challenges. In response, this study presents an innovative and efficient approach to coordinate industrial robot applications with the development of the circular economy (CE), specifically focusing on the adaptation of industrial robots to CE systems. In this regard, the study integrates industrial robot applications with key CE indicators through a coupled collaboration model. Within this framework, all experimental data are transformed into coupling coordination degrees, enabling a quantitative assessment of the internal collaborative relationships within the entire system. The spatiotemporal evolution patterns are examined using kernel density estimation and centroid standard deviation analysis. Next, regional differences and convergence characteristics are analyzed through the Dagum Gini coefficient, together with its decomposition and convergence model. Compared to existing empirical methods, the proposed framework demonstrates a more efficient synergistic development relationship between industrial robot deployment and CE advancement, while simultaneously reducing computational complexity. These findings offer critical implications for promoting industrial upgrading in the industrial robotics sector and advancing CE development, thereby providing valuable strategic insights for policymakers and enterprise managers.

Key words: circular economy; coupling collaborative model; industrial robot applications; regional differences

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* Author to whom all correspondence should be addressed: E-mail: shangyuping1993@163.com, zhaoshin_1993@163.com