

# A study on energy efficiency in robotic systems

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## Abstract

**Statement of the Problem:** Energy efficiency is one of the biggest challenges facing industrial plants. Today, the cost of electricity is an important component of production costs, which directly affects a company's competitiveness. The robotization of production processes plays a key role in industry, helping to increase efficiency, improve quality, reduce the risk of errors and lower production costs. However, the implementation of new technologies is fraught with challenges. Research into energy efficiency is driven by the fact that new opportunities are emerging in strategic decision-making about production processes. The rational use of electricity, especially in the industrial sector, has a significant impact on the reduction of production costs and, consequently, on the company's profit and competitiveness. The issue of energy consumption in robotics is particularly important since the number of installations of robotic workstations is constantly increasing worldwide and robotization is one of the main directions of economic development in industrialized countries. Analyzing the market data related to the creation of automated and robotic production systems, it can be concluded that the trend of implementing robotic systems is growing. The need to reduce costs while maintaining quality and increasing production efficiency has necessitated the implementation of modern solutions related to reducing power consumption. One method is to analyze the demand for electricity and optimize its consumption using appropriate software. An important issue here is how to program the robot's trajectory, especially in the context of the motion instructions.

A 6-axis ABB IRB2600 industrial robot with an anthropomorphic structure is considered. The process of monitoring the power consumption of the manipulator's drive units was performed in the RobotStudio software.

**Conclusion & Significance:** The results of the numerical analysis provide information based on which it is possible to study methods for reducing energy consumption through its efficient use. Real-time monitoring of energy consumption is a useful tool for analyzing different variants of strategies for programming the movement of an industrial robot manipulator, so that it is possible to realize the movement of the manipulator to an assumed destination point along a trajectory that ensures minimum energy consumption, but with the assumed efficiency. Considering that an industrial robot also consumes energy when it is idle (the motors are on to keep the robot arm at rest). Therefore, it is important to optimize the duty cycles to minimize the robot's idle periods.

## Image

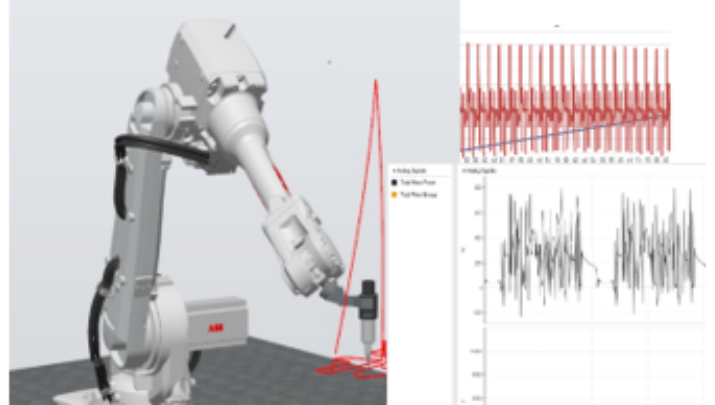


Figure 1. An example of monitoring and measuring a robot's power consumption in the RobotStudio environment

## Recent publications:

1. Sękala Agnieszka, Blaszczyk Tomasz, Foit Krzysztof, Kost Gabriel: Selected issues, methods, and trends in the energy consumption of industrial robots, *Energies*, MDPI, vol. 17, no. 3, 2024, Article number: 641, pp. 1-23.
2. Kampa Adrian, Foit Krzysztof, Sękala Agnieszka, Kulik Jakub, Łukowicz Krzysztof, Mróz Miłosz, Nowak Julia, Witański Marek, Żebrowski Patryk, Błaszczyc Tomasz: Development and testing of the RFID gripper prototype for the Astorino didactic robot, In: *Advanced, contemporary control. Proceedings of the XXI Polish Control Conference*, Gliwice, Poland, 2023.
3. Kochański Adam, Sękala Agnieszka: Przykład syntezy wybranego układu pneumatycznego, In: *Interdyscyplinarne badania młodych naukowców / Balon Barbara (eds.), Monografia / Politechnika Śląska*, no. 987, 2023, Wydawnictwo Politechniki Śląskiej, pp. 258-273.
4. Pac Paweł, Tokarczyk Jarosław, Prostański Dariusz, Sękala Agnieszka, Rosikowski Piotr: Alternatywna metoda analizy wyników symulacji mes w oprogramowaniu CAD bez zaawansowanych narzędzi postprocesingu, In: *Interdyscyplinarne badania młodych naukowców / Balon Barbara (eds.), Monografia / Politechnika Śląska*, no. 987, 2023, Wydawnictwo Politechniki Śląskiej, pp. 330-344.
5. Sękala Agnieszka, Schultz Ole, Foit Krzysztof, Blaszczyk Tomasz: Technical Education for Industry 4.0: Generation Z's motivation to study technical subjects - a comparative study of selected universities in Denmark and Poland, In: *2023 32nd Annual Conference of the European Association for Education in Electrical and Information Engineering (EAEEIE)*, 2023, Institute of Electrical and Electronics Engineers, pp. 1-5,

## Photograph



## Biography

Agnieszka Sękala (presenter), Krzysztof Foit and Gabriel Kost are research and teaching staff at the Faculty of Mechanical Engineering. They work in the field of industrial robotics in general.

Tomasz Blaszczyk is a researcher and lecturer at Zealand University of Applied Science in Denmark. He works in areas ranging from sensor systems for industrial and space applications to robotization and automation in broadly defined sustainable applications.