ISSN: 2832-790X
Online Journal of
Robotics & Automation Technology
DOI: 10.33552/OJRAT.2024.02.000547
Iris Publishers

Mini Review

Certain Problems in the Development of Nanorobots

Mariusz Giergiel*

Department of Robotics and Mechatronics, AGH University of Krakow, Poland

***Corresponding author:** Mariusz Giergiel, Department of Robotics and Mechatronics, AGH University of Krakow, Poland

Received Date: April 26, 2024

Published Date: May 06, 2024

Abstract

An important question for which there seems to be no good, clear answer is the issue of selecting solutions that can be used in the design and practical implementation of nano-scale robots. The root of the problem lies in differences in the fundamental nature of physical phenomena in the macro, micro and nano worlds. This is because some phenomena at the nano scale do not occur in the same way at the micro and macro scale and vice versa. It is important to answer the question what criteria should be considered when constructing nanoscale mechanisms and whether it makes sense to simply scale the mechanisms from our world to the nanoscale.

Keywords: Nanorobots; Nano mechanics; Nano drives; Bio applications

Introduction

The dynamic development of technology, including some aspects of nanotechnology, visible in recent years, opens several new possibilities in various fields, including nanorobotics and nano mechanics [1,2]. Already in 1959, physicist Richard Feynman gave a popular science lecture in which he considered the limits of miniaturization [3]. In his considerations, he started with contemporary technology, then analyzed the limitations resulting from physical laws and concluded with the statement that it will be possible, even inevitable, to construct objects at the atomic level, atom by atom [4]. Reaching this level of technology seemed an unlikely task at that time. However, no one currently questions this goal. After decades, thanks to technical progress, the size of microelectronic devices has approached the molecular scale, and the progress of scientific research at the molecular level, especially molecular systems functioning in living systems, has made the public aware of what the genius had already noticed many years ago. Nanotechnology [2] can best be defined as a description of activities at the level of atoms and molecules that have applications in the macro world. It is undoubtedly a great challenge to measure, manipulate and perform various types of activities at the scale from 1 to 100 nm. To achieve efficiency in the field of nanotechnology, it seems necessary to automate molecular production. Devices that are responsible for all kinds of operations at the nanoscale are called nanorobots [4,5]. Basically, a nanorobot is a controlled machine on a nano or molecular scale that is composed directly of nano components. And nanorobotics itself deals with the design, production, programming and control of nanorobots.

Problems with nanorobotics

To this day, despite many loud announcements, we have not seen a dynamic development of nanorobotics [4]. In addition, nanotechnology itself still seems to be a niche area and its development is essentially limited to materials engineering. The answer to the question why this is happening is not entirely obvious, after all, there is demand, and if it exists, there are funds for research and development work. After all, the ability to construct devices with molecular precision will revolutionize the industrial production process by significantly improving the properties of materials and significantly improving the performance of various devices. The problem is that there is a problem, i.e. we see something like tautology. So, what exactly is the problem that nanorobotics is not developing as promised? How and from what to build a nanorobot? As shown in [1], for mobile robots created on the nano scale, the planetary gear is practically useless. However, for example, a straight gear modeled in the NanoEnginner-1 program [6] and shown in Figure 1 will function, but its low gear ratio makes it practically useless.

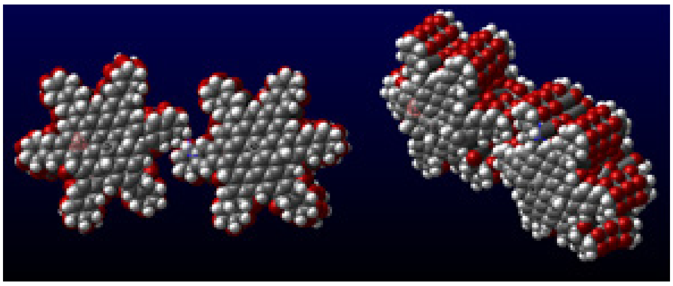

Figure 1: Straight gear, front and axonometric view.

Another and probably even more serious problem is the driving engines, energy sources and the control system. First, some physical parameters. The density of silicon atoms is 2330 kg/m^3 [7]. This means that the average distance of atoms is 0.27 nm, so in 5 nm technology the number of atoms along the side of the gate is only about 10 atoms. The dielectric strength of silicon dioxide is 5-10 MV/cm. This means that a voltage of 5 V with an insulating layer thickness of 10 nm (about 30 atoms) is on the border of breakdown resistance. The monoatomic layer withstands a voltage of approximately 0.17 V. In practice, this means that it is not possible to build a control system with the computing power we are accustomed to in the macro world. The situation is equally bad in terms of the possibility of physically implementing engines based on known principles and according to known macro-scale solutions. Also, the possibility of developing power sources in the form of batteries or accumulators with the required capacities is completely unrealistic. Additionally, the matter is complicated by the fact that, given the dimensions resulting from the nanoscale requirements, radio communication and data transmission between nanorobots and the outside world should be considered impossible. Here, in addition to the limitations already presented, an additional problem is the impossibility of implementing an antenna system with practically useful efficiency.

Conclusion

Therefore, the situation in terms of the possibility of building and using nano-scale robots seems hopeless. And in fact, it will remain like this if we do not change our approach to their design, if we blindly stick to technologies and solutions that are successfully used on a macro and micro scale, but do not work and are not possible to use on a nanorobot scale. Yet there are living organisms in nature that operate effectively on the nano scale. This means that bio nanotechnologies [8] may be the way to solve the problems, and this is where we should see a chance for the actual development of nanorobotics.

Acknowledgments

None.

Conflict of Interest

No conflict of interest.

References

1. Giergiel M (2020) Possibilities of using nano mechanisms for robots built at the nanoscale (in Polish). Design of mechatronic systems, selected issues, KRiM AGH, Kraków pp. 61-66.
2. Kelsall R, Hamley I, Geoghegan M (2005) Nanoscale Science and Technology, John Wiley & Sons, Ltd.
3. Roukes M (2001) Nanoelectromechanical systems face the future, Physics World 14 (2): 25-31.
4. Khulbe P (2014) Nanorobots: A Review, Int J Pharm Sci Res 5(6): 2164-2173.
5. Yang J, Zhang C, Wang X, Wenxue Wang, Ning Xi, et al. (2019) Development of micro- and nanorobotics: A review. Sci. China Technol. Sci 62: 1-20.
6. https://sourceforge.net/projects/nanoengineer-1/ [Accessed: 11.02.2024].
7. Meija J, Tyler B Coplen, Michael Berglund, Willi A. Brand, Paul J De Bièvre et al. (2013) Atomic weights of the elements 2013 (IUPAC Technical Report), Pure and Applied Chemistry 88 (3): 265-291.
8. Gaiseanu F (2021) New Perspectives in Biomedical Engineering and Biotechnology: Information in Human and Biological Structures. Arch Biomed Eng & Biotechnol 6(1).