International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 3 | Issue 3 | ISSN : 2456-3307

Amalgamating Nanoscience with Robotics Technology to Influence the Behaviour of Fractal Robots: A Focus on Future Applications

Rajesh Harikrishnan
Sr. Assistant Professor, Department of Computer Science and Applications, New Horizon College, Marathalli, Bangalore, Karnataka, India

ABSTRACT

There are discussions happen all around the world signifying that the area of robotics is popularizing its research outcomes and its great transformation. Robots become the science talk of every techie. Large number of companies started making projects and researches in almost every country. The objective of this paper is to introduce the concept of fractal robots and its growing demand and application in upcoming era. The new science of fractal geometry offers very exciting possibilities in various fields especially in nano robotics. This paper gives an integrated analysis of fractal robots and its role in nano robotics, which promises to revolutionize robotics technology with integrating nano science in a way that which will cause the future life of human by affecting the function and environment but not the structure and origin.

Keywords: Robotics, Nano science, Fractal robots

I. INTRODUCTION

A. Robotics – A Big Coverage Field

Robotics is a huge research area and it can be applauded as the apex of emerging technologies integrating the various fields like mechanical, electrical, electro mechanical etc. The recent developments in Robotics have got well transfigured in the domains like biometrics, mechatronics, artificial intelligence, Swarm intelligence. Restoring the potential powerful technology will results more improvements in its quality and consumption.

Most of the design proposals connected with robots have been eradicated by the other technologies such as the use of cloud computing and big data analytics. Machine automation helps in developing robots with distinct principles. The high level modeling and customization are required to construct robots in a quality manner [2]. To provide innovative, flexible, efficient and less expensive robotic solutions, the current state-of-the-art of robotics has to be reconfigured with the upgraded intelligent control, advanced sensor processing and modernized computer programming. In this, Nano robotics requires a lot of analysis and research ideas to put in to practice.

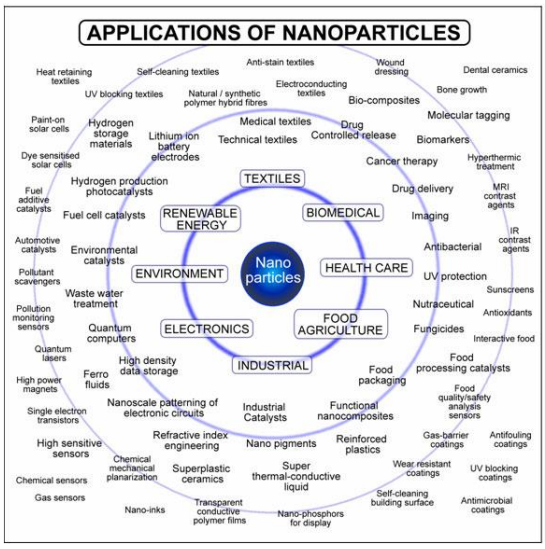

Figure 1. Nanoscience applications

B. Nano Robotics – A massive research perspective

Nanorobots with completely artificial components have not been realized yet. The active area of research in this field is focused more on molecular robots, which are thoroughly inspired by nature's way of doing things at nano scale. [3]. The Nature's structure of molecular machines that have been functioning for centuries, and have been optimized for performance and design over the ages. From this energy, as we are creating synthetic ones from scratch, using nature's components with the support of increased number of machines.

C. Nanotechnology: Intersection with Robotics

Nanotechnology is the science and application of creating objects on a level smaller than 100 nanometers. The extreme concept of nanotechnology is the "bottom up" creation of virtually any material or object by assembling one atom at a time. Although nanotech processes occur at the scale of nanometers, the materials and objects that result from these processes can be much larger. Large-scale results happen when nanotechnology involves massive parallelism in which many simultaneous and synergistic nanoscale processes combine to produce a large-scale result. Nanotechnology spans and merges disciplines dealing with matter at the micro level in combination with physics, chemistry, and biology with those dealing with matter at the macro level in combination with engineering, materials science and computer science.

II. FRACTAL ROBOTS

A. A geometric approach of Nano science

Fractal geometry plays a vital role in robotics technology. The term "Fractal" means linguistically "broken" or "fractured", which describe a family of complex shapes that possess an inherent self-similarity or self-affinity in their geometrical structure. A self-similar object appears unchanged after increasing or shrinking its size. Similarity and scaling can be obtained using an algorithm. Repeating a given operation over and over again, on ever smaller or larger scales, culminates in a self-similar structure. Here the repetitive operation can be algebraic, and then different branches of science discovered their practical applicability. Fractal robots provide benefits in the reduction in size, and cost and increased wide bandwidth. The geometry of fractals proves to be helpful in the design of antennas, robotics and military applications [2]. "Fractal Robots" are objects made from Cubical bricks that can be controlled by a computer to change shape and to reconfigure themselves into objects of different shapes. These cubic motorized bricks can be programmed to move and shuffle themselves to change shape to make objects like a house potentially in few seconds. This technology has the potential to penetrate every field of human work like construction, medicine, research and others.

III. NANO MANUFACTURING

A. The Principles of Nano Manufacturing:

Nano manufacturing is the creation of materials and products through:

1) Direct Molecular Assembly (DMA) -- discrete, directed assembly of individual atoms and molecules into macroscale materials and products
2) Indirect Crystalline Assembly (ICA) -- creation of conditions that foster the growth of nanoscale crystals that are then combined into macroscale materials and products;
3) Massive Parallelism Assembly (MPA) -- the creation of many nanomachines or nanobots whose operating parameters cause them to work synergistically to assemble atoms and molecules into macroscale materials and products. [1]

Nanocrystalline processes can also be used to grow electronics components.

1. Carbon nanotubes grown in targeted micro-environments can have super-conductive properties; and

2. Nanowires as small as strings of atoms can be grown like crystals and then assembled into circuits. Circuits created atom-by-atom or grown using nanocrystalline techniques will be much smaller, lighter, efficient, cooler, stronger, and faster than circuits made with conventional manufacturing processes. [1]

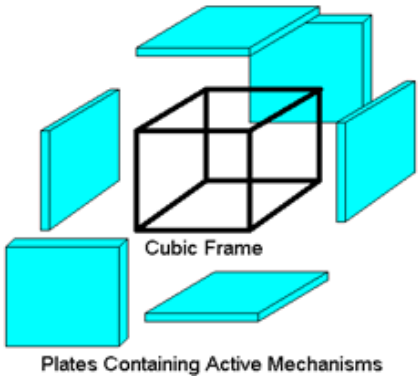

Figure 1. Assembly of the Cubes

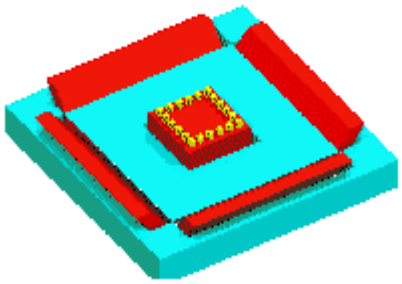

Figure 2. Faceplates of the cubes that have electrical contact pads

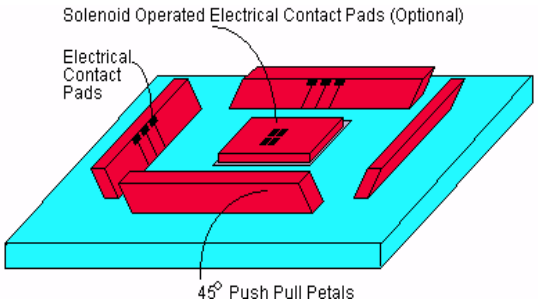

Figure 3. Contact pads are mounted on the plates and a solenoid operated pad

Figure 4. Contact pads are arranged symmetrically around four edges to perform rotational symmetry

IV. NANO TECHNOLOGY

A. Nano Technology Applications as Integrated Building Blocks

Nanotechnology has more energy-related applications. Nanotechnology spans and merges disciplines dealing with matter at the micro level such as physics, chemistry, and biology with those dealing with matter at the macro level such as engineering, materials science and computer science. Nanotechnology coatings are already being used to make clothing with stain-resistant fibers. Nanotech powders are already being used to formulate high-performance sun-screen lotions. Nanoparticles are already helping to deliver drugs to targeted tissues within the body. [2]

1) Electrical Energy

Nanophotonics is the application of nanotechnology to the transformation of electricity to light or light to electricity. Nanocrystals or nanophosphores can make this transformation with greater efficiency than traditional incandescent lighting or solar panels. Nanoceramic material are used as cover for batteries absorbs electromagnetic waves and prolongs battery life. Nanopolymers provide high-performance insulation for energy transmission lines and decrease energy loss across long distances.

2) Telecommunications

Nanocrystalline materials can be made with finer resolution than standard fibers for enhanced optic cables, switches, lenses and junctions.

3) Sports

Nanotechnology is already being used for several sports and recreation related applications. For example, nanotech tennis rackets and golf clubs are lighter, stronger, and can be engineered to provide more motion control. Nanotech coatings on swim suits repel water, reduce friction with the water, and allow swimmers to go faster.

4) Medicine

Medicine and biomedical research opens up new opportunities to treat illnesses, repair injuries, and enhance human functioning beyond what is possible with macroscale techniques. Nanoparticles can attach to certain cells or tissues and provide medical images of their location and structure. Hollow nanocapsules with pharmaceutical contents can attach to cancer cells and release their payloads into them by maximizing targeted delivery and minimizing systemic side effects. Nanomedibots may repair vital tissue damaged by injury or disease, or destroy cancerous tissue that has gone awry, without invasive surgery. In orthopedics field, Grafts of natural bone. Artificial bone cement without nanotechnology in which artificial bone paste made with Nanoceramic particles shows considerable promise for bone repair and replacement.

5) Pharmacy

Nanopharmacology is the application of nanotechnology to the discovery of new molecular entities with pharmacological properties. Nanotechnology is also useful for individualized matching of pharmaceuticals to particular people to maximize effectiveness and minimize side effects. It is also used for delivery of pharmaceuticals to targeted locations or specific types of tissue in the body.

V. FUTURE OF FRACTAL ROBOTS

Basic nanomachines are already in use. Nanobots will be the next generation of nanomachines. Advanced nanobots will be able to sense and adapt to environmental stimuli such as heat, light, sounds, surface textures, and chemicals; perform complex calculations; move, communicate, and work together; conduct molecular assembly; and, to some extent, repair or even replicate themselves.

Invisibility Cloak: The new frontier of fractal science called, Invisibility cloaks, popularized in science and fantasy fiction, are devices intended to make the 'object', or wearer, disappear into the background. The invisibility cloak has unique characteristics, because it makes use of the fractal approach. Fractals have been applied as a descriptor of many physical structures such as terrain; clouds; vegetables; trees; anatomical organs; galactic clusters; lightning; and so on. [3]

VI. CONCLUSION

Basic nanomachines are already in use. Nanobots will be the next generation of nanomachines. Advanced nanobots will be able to sense and adapt to environmental stimuli such as heat, light, sounds, surface textures, and chemicals; perform complex calculations; move, communicate, and work together; conduct molecular assembly; and, to some extent, repair or even replicate themselves.

Nanotechnology will be able to create nanobots that emulate certain functions of biological entities, but the structures and origin of nanobots will likely remain quite different than those of biological entities. Nanotechnology has the potential to completely revolutionize the electronics industry. Nanomachines may someday create computer circuits from the "bottom up" one atom at a time. This would allow the manufacturing of

nanochips on a much smaller scale than chips created with current “top down” etching techniques.

VII. REFERENCES

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