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Solution And Visualization 3D Plane Inverse Kinematics Method

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ABSTRACT

The hyper-redundant type of robot is a type of robot that in carrying out its duties in the field of kinematics its degrees of freedom exceed the required minimum degrees. The advantage will be increased capability in operation and performance, if the degrees of freedom are excessive, even in unorganized and complex systems and environments. Algebraic approach method in inverse kinematics algorithm analysis can use; analytic algebra, jacobian basis, analytic KI, exponential multiplication, grobner, and conformal geometry. Iterative approach method in inverse kinematics algorithm analysis can use; genetic algorithm, fuzzy logic, ANFIS, and evolutionary algorithm. The geometric approach method in the inverse kinematics algorithm analysis can use; capital method. The purpose of this study is to analyze a virtual 2 arm robot, which will use axis manipulation in three dimensions using an inverse kinematics solution, using a geometric approach. How to step along on the z axis by rotating and using the reverse kinematics solution to the desired location. The visualization results will be repeated so as to ensure the effectiveness of the algorithm. As for this algorithm will provide a single solution, and this algorithm will prevent and reduce singularities if the link is lower.

Keywords: Robot arm analiysis, hyper-redundant robot, Mathlab software

INTRODUCTION

The hyper-redundant robot type is a type of robot that has more degrees of freedom than the minimum required for its kinematic tasks (Martin & Schaub, 2022). This excess of degrees of freedom can increase the robot's ability to do its job and improve its overall performance. However, it is important to note that too much freedom can also be detrimental, as it can lead to confusion and inefficiency in disorganized and complex systems and environments.

Despite this, the hyper-redundant type of robot is highly useful in various fields such as the military and industrial sectors (Singh & Banga, 2022). Its ability to perform tasks with a high degree of freedom can make it an ideal tool for tasks that require precise movements or manipulation of objects. For example, it may be used in manufacturing to assemble complex parts, or in the military for bomb disposal or search and rescue missions. Overall, the hyper-redundant type of robot offers many advantages due to its high degree of freedom, but it is important to carefully consider the benefits and limitations of this design in specific applications and environments (Martin & Schaub, 2022).

In applications such as emergencies, the hyper-redundant type of robot can be an effective tool due to its ability to perform tasks with a high degree of freedom (Lin et al., 2020). This can allow it to navigate and manipulate objects in complex and unstructured environments, such as cleaning dirty or damaged parts in an engine, inspecting road connections, inspecting space shuttles, or inspecting nuclear power plants.

To ensure the accuracy and efficiency of the robot in these tasks, it is important to have a well-designed algorithm or workflow that can guide the robot's actions (Marion et al., 2017). The inverse kinematics algorithm is a very important tool in analyzing the control of robots, as it can analyze redundant manipulators and determine the final position and orientation of the effector (Almaged, 2017). However, it is also important to consider the variables required for the actuator in order to ensure the accuracy of the system.

Inverse kinematics methods can be classified based on their approach, including iterative, geometric, and algebraic methods (Almusawi et al., 2016). Each of these approaches has its own strengths and limitations, and it is important to choose the most appropriate method based on the specific needs and requirements of the application (Queirós et al., 2017).

The algebraic approach method in the analysis of inverse kinematics algorithms involves using techniques such as analytical algebra, jacobian basis, analytical KI, exponential multiplication, Grobner, and conformal geometry to solve the equations and determine the required joint angles for a given task. This method is often used when the robot's kinematic structure is well understood and the equations can be solved analytically (Lutter & Peters, 2021).

The iterative approach method in inverse kinematics algorithm analysis involves using techniques such as genetic algorithms, fuzzy logic, ANFIS, and evolutionary algorithms (Almusawi et al., 2016). These methods involve repeating an optimization process until a satisfactory solution is found, and are often used when the robot's kinematic structure is more complex or when analytical solutions are not possible (Aristidou et al., 2018). The method of geometric approach in the analysis of the inverse kinematics algorithm involves using techniques such as the capital method. This method involves using geometric techniques to solve the equations and determine the required joint angles for a given task (Mu et al., 2018). It is often used when the robot's kinematic structure is complex and analytical or iterative methods are not feasible (Park et al., 2020).

Overall, there are several different methods that can be used to analyze inverse kinematics algorithms, and the most appropriate method will depend on the specific needs and requirements of the application (Aristidou et al., 2018). Unfortunately, the algebraic approach to inverse kinematics analysis can be computationally intensive due to the use of symbolic expansion (Nag et al., 2021). This can make it difficult to apply in real-time or high-speed applications. Additionally, this approach may not always provide a clear indication of the optimal solution, and there may be multiple potential solutions for different arm configurations (Cicali et al., 2019). The iterative approach to inverse kinematics analysis may also have a significant computational burden, especially if it takes a long time to find a solution (Aristidou et al., 2018). However, this method has the advantage of being able to handle more complex kinematic structures and can often find a solution even when an analytical method is not possible.

An alternative approach is the geometric approach, which can use geometric heuristics and approximations to directly solve for the required joint angles (Garrett et al., 2018). This method can be less computationally intensive than the algebraic or iterative approaches and may provide a more direct solution. However, it may not be suitable for all types of kinematic structures and may have its own limitations and challenges. Overall, the choice of inverse kinematics analysis method will depend on the specific needs and requirements of the application, and it is important to consider the trade-offs between computation time, solution accuracy, and the complexity of the kinematic structure (Bakulin et al., 2021).

The purpose of this study is to analyze a 2-arm robot virtually using a geometric approach and an inverse kinematics solution to perform axis manipulation in three dimensions. This research aims to address potential gaps in the existing literature on this topic, including the use of a geometric approach in inverse kinematics analysis of 2-arm robots. While algebraic and iterative methods have been commonly used in inverse kinematics analysis, the use of a geometric approach may offer unique benefits and insights (Aristidou et al., 2018). This study aims to explore the potential advantages and limitations of using a geometric approach for inverse kinematics analysis of 2-arm robots.

By exploring the use of a geometric approach for inverse kinematics analysis of 2-arm robots, this study aims to contribute to the field of robotics and control and provide valuable insights into the potential benefits and limitations of this approach. By addressing potential gaps in the existing literature, this study aims to advance our understanding of this topic and improve the performance and efficiency of 2-arm robots in various applications.

Another potential research gap is the focus on virtual analysis of 2-arm robots. While there has been a significant amount of research on the control and manipulation of physical robots, there may be fewer studies that focus on virtual analysis. This study aims to contribute to the body of knowledge on virtual analysis of robots, and to understand the potential benefits and challenges of using this approach. Overall, this study aims to fill gaps in the existing literature by exploring the use of a geometric approach for inverse kinematics analysis of 2-arm robots, and by focusing on virtual analysis of these systems. By addressing these research gaps, this study aims to provide valuable insights and contribute to the field of robotics and control.

RESEARCH METHOD

The algebraic approach method in the analysis of inverse kinematics algorithms (Wei et al., 2014) involves using techniques such as analytical algebra, Jacobian basis, analytical KI, exponential multiplication, Grobner, and conformal geometry to solve the equations and determine the required joint angles for a given task. This method is often used when the robot's kinematic structure is well understood and the equations can be solved analytically. The iterative approach method in inverse kinematics algorithm analysis involves using techniques such as genetic algorithms, fuzzy logic, ANFIS, and evolutionary algorithms (Samarakoon et al., 2021). These methods involve repeating an optimization process until a satisfactory solution is found, and are often used when the robot's kinematic structure is more complex or when analytical solutions are not possible.

The method of geometric approach in the analysis of the inverse kinematics algorithm involves using techniques such as the capital method. This method involves using geometric techniques to solve the equations and determine the required joint angles for a given task. It is often used when the robot's kinematic structure is complex and analytical or iterative methods are not feasible. Overall, there are several different methods that can be used to analyze inverse kinematics algorithms, and the most appropriate method will depend on the specific needs and requirements of the application.

RESULT AND DISCUSSION

The picture in the statement appears to show different positions of a robot's end effector on the z-axis, in four different quadrants (Avalle et al., 2019). It appears that the length of the robot's links is fixed and that the positions are plotted based on different unit lengths. Based on the description provided, it appears that the first square in the picture represents the final position of the end effector on the positive z-axis, with a link length of (2,1,1). When plotted with a unit length of 1, the final position of the end effector is (2,1,1). The eighth elbow position, with a link length of (5.5, 4.3, 2), has a final end effector position of (5.5, 4.3, 2). With a unit length of half, the 16th elbow position has a final end effector position of (3, 4, 1), and the 4th elbow position has a final end effector position of (3, 2, 1) with a unit length of 1. Overall, it appears that the purpose of this visualization is to show the relationship between the length of the robot's links and the final position of the end effector on the z-axis in different quadrants.

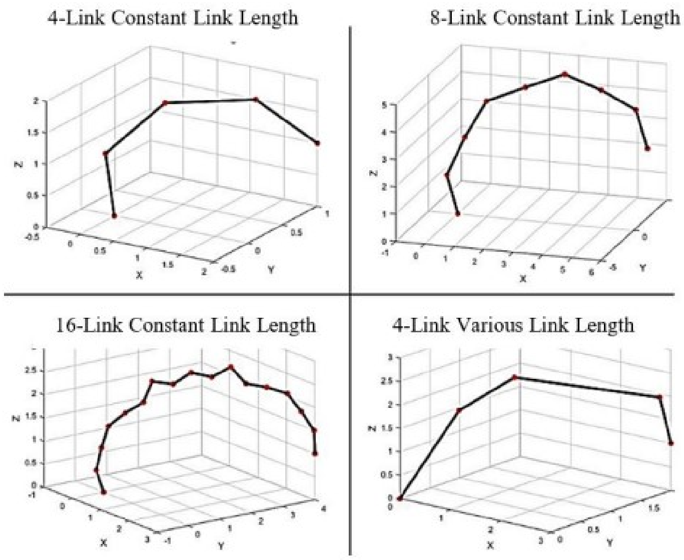

Figure 1. Simulation on positive z

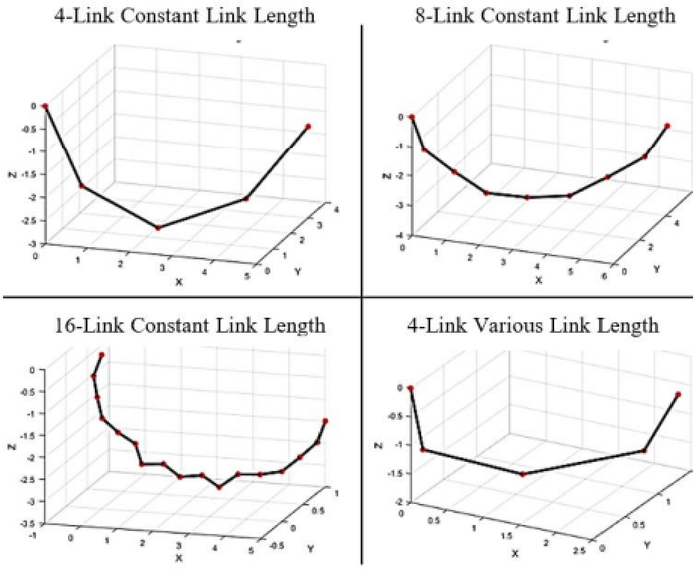

Figure 2 Simulation on negative z.

The picture above appears to show the results of an algorithm when applied to the negative z-axis of a robot. This visual representation is intended to help understand how the algorithm performs and what the resulting output looks like. The picture may include information such as the positions of different parts of the robot, the movements of the robot's arms, or any other relevant data. By analyzing this visual representation, it is possible to gain insights into the performance of the algorithm and how it is affecting the robot's movements and positions. Overall, the picture is intended to provide a visual representation of the results of the algorithm, and to help understand how it is performing and what the resulting output looks like (Shorten & Khoshgoftaar, 2019). By analyzing this visual representation, it is possible to gain insights into the performance of the algorithm and how it is affecting the robot's movements and positions (Petrich et al., 2022). Visualizing the results of an algorithm is an important way to gain a better understanding of how it works and what it is capable (Fan et al., 2017). By looking at a visual representation of the results, it is possible to see how the algorithm is affecting the movements and positions of the robot and to identify any potential issues or problems (Joshi et al., 2020).

Using this visual representation, it is possible to identify areas for improvement in the algorithm and to optimize its performance. For example, if the visual representation shows that the robot is not moving accurately or efficiently, this may indicate a need to adjust the algorithm or to modify the robot's design (Ben-Ari & Mondada, 2018). In addition to understanding the results of the algorithm, the visual representation may also provide insights into the performance of the robot itself (European Society of Radiology (ESR) communications@ myesr. org Neri Emanuele de Souza Nandita Brady Adrian Bayarri Angel Alberich Becker Christoph D. Coppola Francesca Visser Jacob, 2019). For example, it may show how accurately the robot is able to move and manipulate objects, or how efficiently it is able to complete tasks. By analyzing this visual representation, it is possible to gain a better understanding of the capabilities and limitations of the robot, and to identify areas for improvement (Alam, 2022).Overall, the picture above provides valuable information about the performance of the algorithm and the capabilities of the robot, and can be used to improve and optimize both the algorithm and the robot's performance.

Based on the description provided, it appears that the picture above shows the locations of a robot's end effector at different elbow positions on the negative z-axis. The end effector's position is at (5, 3, -1) on the 4th elbow, while at the 8th elbow the end effector's final position is (6, 4.2, -1) with a unit length of 1. The end effector's position is (5, 1, -2) with a unit length of 0.5 at the 16th elbow, and there are also positions of the end effector at (2.5, 1.3, -0.5) with various units of length at the elbows of 4 HRR robots. The picture appears to show that both negative and positive quadrants can be implemented in 3-dimensional space (Bostan et al., 2016), and that simulations performed from various elbows also accommodate down and up elbow configurations (Winston & Jamali, 2022). The test also consistently formed coils at the 4th and 8th elbows on the HRR (Rosheim, 1994). Overall, it appears that the picture is intended to show the locations of the end effector at different elbow positions on the negative z-axis, and to provide insights into the performance of the robot and the algorithm being used to control it.

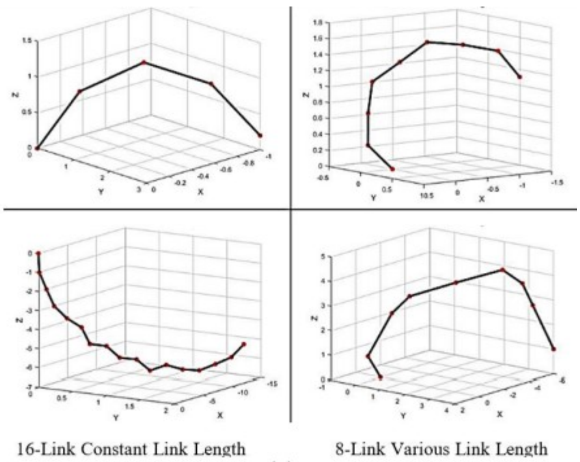

Figure 3. The final position of the effector is in quadrant 2, on the positive z-axis

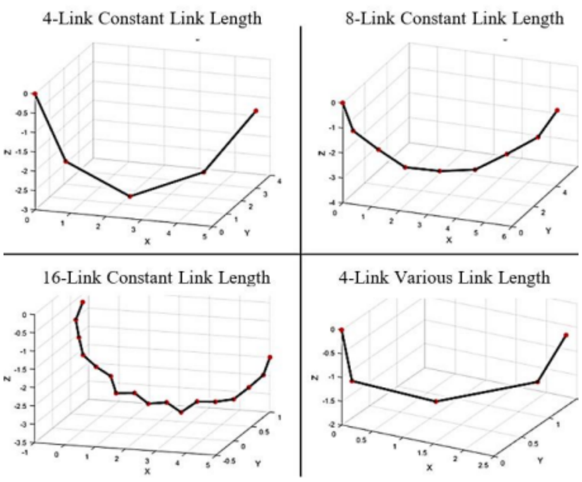

Figure 4. The final position of the effector in quadrant 1, on the negative z-axis

Based on the description provided, it appears that the picture shows that only part of the support at the end of the HRR elbow is at the 16th elbow. The elbow lengths of 16 and 8 are still more or less better than the elbow lengths of 4 and 8. This is because the zigzag shape of links 8 and 16 means that it is possible for the final effector location to be not reached, and this can prevent singularity from occurring. To make the HRR have a 2-m link count, the link must be forced to lock in the simulation with another link (Chen, 2007). This is because there are links that are not 2-m that will not be used in the calculation (Lü & Zhou, 2011).

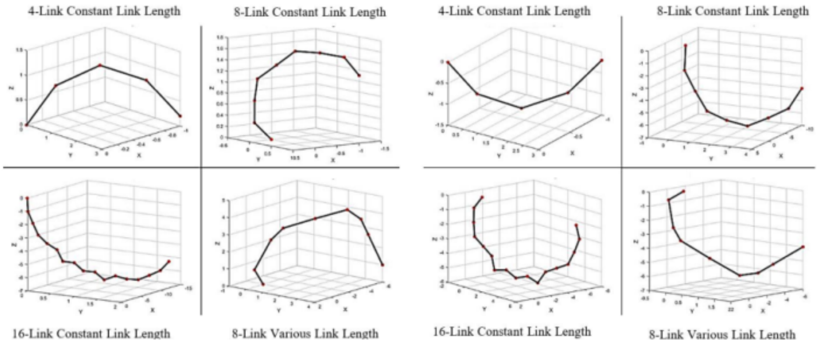

Figure 5. The final position of the effector in the 2 quadrant

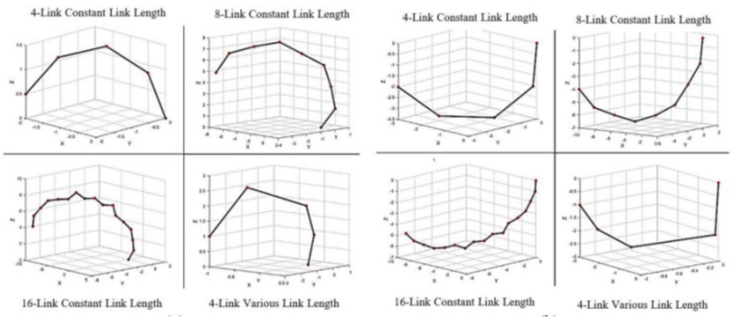

Figure 6. The final position of the effector in the 3 quadrant

Based on the description provided, it appears that the 4th corner of the HRR will change due to a locking link from the 5th corner of the HRR, resulting in the HRR being one link larger than before (Knez & Camerer, 1994). Additionally, the algorithm being used is expected to provide a single solution, which may be an advantage compared to algorithms that typically require multiple solutions (Deb, 2003). Another advantage of this algorithm is that it may prevent and reduce singularity if the link is lower (Levy & Lindenbaum, 1998).

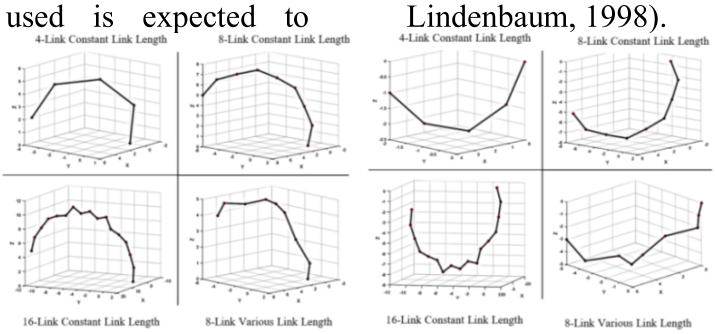

Figure 7. The final position of the effector in the 4 quadrant

Overall, it appears that the algorithm being used is intended to provide a single solution and to prevent and reduce singularity in the HRR robot. It is not clear from the description provided how the algorithm is achieving these goals or what specific benefits they may provide.

CONCLUSSION

Based on the description provided, it appears that this research is focused on the development and study of algorithms for 3-dimensional inverse kinematics of 2-arm robots. The goal of the study is to understand how to move the arms of the robot along the z-axis and to the desired location using an inverse kinematics solution and rotation. The mathlab tool is being used to simulate the algorithm and visualize the results.

The results of the visualization will be repeated to ensure the effectiveness of the algorithm. It is stated that the algorithm being used will provide a single solution, which may be an advantage compared to algorithms that typically require multiple solutions.
Additionally, the algorithm is expected to prevent and reduce singularity if the link is lower. Overall, it appears that this research is focused on the development and study of algorithms for 3-dimensional inverse kinematics of 2-arm robots, with the goal of understanding how to move the arms of the robot along the z-axis and to the desired location using an inverse kinematics solution and rotation. The mathlab tool is being used to simulate the algorithm and visualize the results, and the results will be repeated to ensure the effectiveness of the algorithm. The algorithm is expected to provide a single solution and to prevent and reduce singularity if the link is lower.

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