

Advanced robotic manipulator renewable energy and smart applications

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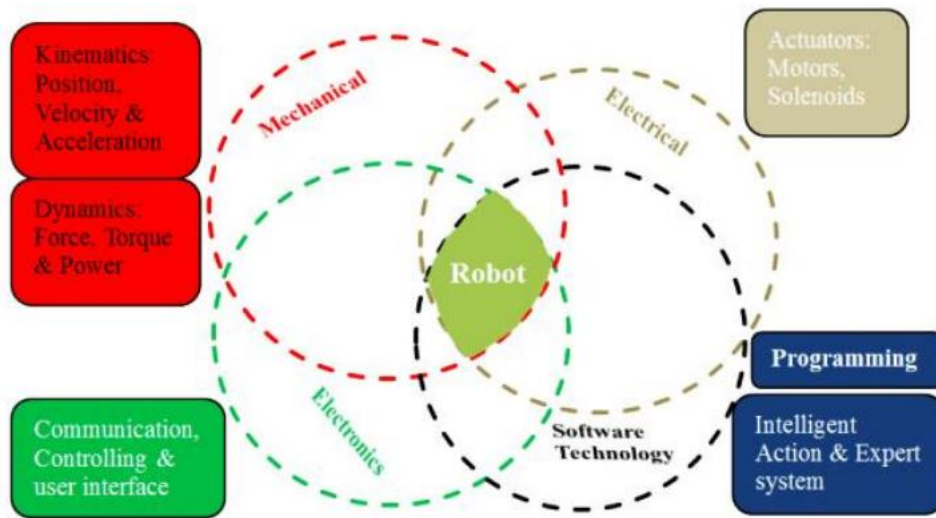
Abstract:

There is a hybrid robotic manipulator that can move item available. A base with a waist mounted on it and set up to spin on the base makes up the hybrid manipulator. A pair of arms positioned on the waist is another feature of the hybrid manipulator. Each arm consists of an upper arm, a forearm connected in collection to the top arm on the elbow, and a wrist designed to enrol in the two palms at their distal ends the use of two connecting elements. The wrist also has an end-effector installed on it that can grab the object and move it to the correct position. A hybrid manipulator is created by combining serial and parallel manipulator systems in a beneficial way. It combines the beneficial performance traits of a parallel manipulator and a serial manipulator. A 3 DOF symmetric planar manipulator serves as the foundation of the hybrid manipulator under research, which was then put over a single platform with the necessary mounted at the end.

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1. Introduction

New technologies are created to meet the growing demand for goods and services. Robots are gaining ground in production and service operations thanks to their adaptability, automation, and lower cost compared to specialized machinery [1-8]. These benefits have encouraged the study and creation of such robots. Figure 1 illustrates how the design of a robot, a multidisciplinary engineering device [9-12]. The kinematics, dynamics, and structural requirements they built a robot are covered in mechanical portion. The actuators that produce the primary motion in the robots' joints are the focus of the electrical section [13-18]. Robot perception, sensing, and control are all covered by system design. The software technology incorporates algorithm and intelligence into the root, allowing it to operate independently or under the guidance of a professional.

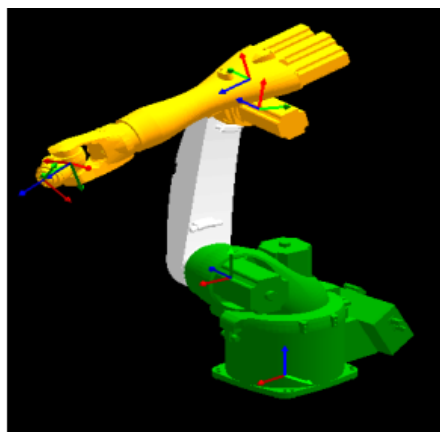


Robotics is multidisciplinary, as shown in Figure 1.

The three main categories of manipulators are determined by the kinematic structure:

- [i] Serial robots or open loop manipulators
- [ii] Parallel Robots or Closed Loop Manipulators
- [iii] Hybrid manipulator (figure 4)

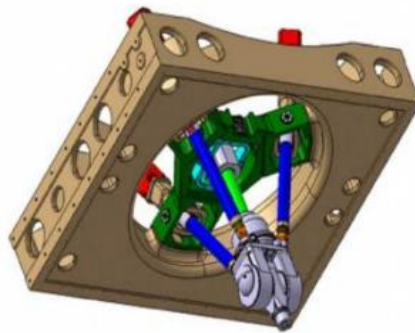
Figure 2 depicts a KUKA 650 Industrial Manipulator, a serial robot with six DOF. An example of a parallel robot with six degrees of freedom is shown in Figure 3. An illustration of a serial parallel hybrid robot with 6 DOF is shown in Figure 4.



Robot KUKA 650 in Figure 2.



ABB Delta Robot in Figure 3.



Serial Parallel Robot (Figure 4)

In comparison to parallel robots, the serial manipulator has a bigger workspace and greater dexterity, but it lacks stiffness and positional accuracy[19-26]. While parallel manipulators are stiffer and lighter, they are not appropriate for vast work spaces due to their constrained workspace and complicated kinematics[27-33]. The advantages of both parallel and serial robotics are combined in hybrid manipulators. Hybrid robotic manipulators, may be built by combining the two types of manipulators. As a result, a hybrid manipulator emerges as a plausible contender to carry out a variety of tasks related to complex geometries[34-40].

2. Reading Survey

The design, manipulation, and performance features of a hybrid manipulator have been researched in a variety of study areas. The serial, parallel, and hybrid configurations were each referenced to and analyzed independently in order to discuss the current design.

2.1 Serial Controller

Manipulators were developed to lessen the laborious and repetitive tasks that required human labor. Links and kinematic joints make up the manipulation system to offer a degree of freedom. Mechanism theories propose a synthesis of spatial and planar mechanisms with numerous degrees of freedom. Cubero outlines a design method to the examination of the kinematic chain of an industrial manipulator. The technique produces flat mechanical structures with various degrees of freedom. Singh et al.'s computer technique for resolving robot kinematics using differential transformation matrix theory and D-H Parameters. For the inverse translation of the kinematics of robot relate the joint angles, Pashkevich created methods. The found solutions have don't be intimidated by his large size, including sites for singularities. Dynamic algorithms and inverse kinematics were also covered in. In this instance, the joint actuation (torques and forces) is used to operate the robot and create the end effector trajectory. As the number of linkages rises, so does the complexity of inverse kinematics.

2.2 Parallel Manipulator

Based on screw theory, Hunt investigated the kinematics of parallel manipulators. The workspace for existing parallel manipulators is constrained, complex, contains singularities, and has very non-isotropic input/output relations. As a result, depending on the workspace and the motion's direction, performances may vary greatly. A 3R symmetric planar platform has a non-singular assembly mode shifting trajectory, according to Chablat and Wenger's inverse kinematic solution. Do and Yang solved the inverse dynamics of a parallel platform using the Newton-Euler method while assuming asymmetrical legs and frictionless joints. One planar parallel manipulator is the subject of kinematic studies by Shirkhodaie and Soni, Gosselin and Angeles, Pennock and Kassner, and Gosselin and Angeles. A general calculation approach for the dynamics and kinematics of parallel or planar robots is presented by Gosselin et al. in their paper from page 24.

2.3 S-P Hybrid Manipulator – Study of Architecture Multiple topologies that combine closed and open loop links use hybrid manipulators. This section presents a few inventive hybrid architecture implementations that are appropriate for various applications. This will give you more knowledge about hybrid manipulators, their potential uses in the present and the future. Through linear driving and simple control, six DOF motion is made possible and could be used in surface manufacturing. For tackling precise tasks, an unique dexterous multiple manipulator object coupled serially by two compliant parallel stages is described. Three-RPS and

three-RRR mechanisms are used in the higher and lower stages, respectively. Optimal design has been attained thanks to the physical model of the solution space technique.

Ota et al. introduced a six-legged robot that walks by moving each leg base alternately through a six degrees of freedom mechanism. The robot has two leg bases and three legs. It was discovered that adopting a hybrid mechanism might result in high performance after comparing the force, velocity, and moveable scope of different mechanisms attach the two legs bases.

2.4 S-P Hybrid Manipulator – Kinematics studies forward and inverse kinematics want to be researched with a purpose to assemble and version a hybrid manipulator. The kinematic and dynamic look at of a ten DOF hybrid manipulator changed into examined by using Waldron et al.

FK but not IK, closed form polynomial answer changed into received. by using price kinematics evaluation, Lee and Kim mounted a projection technique for the kinematic look at of a 6 DOF hybrid manipulator. however, there was no discussion of the FK and IK displacement analysis. Shukla and Paul added the idea of a "virtual hyperlink," wherein the hybrid manipulator may be idea of as an equivalent serial link and the parallel structure as a digital link. however kinematic models are challenging to increase. in an effort to create a hybrid robot for deburring packages, Yang et al. described a modular approach and produced closed form kinematic solutions that had been confirmed through simulations. The created prototype makes use of an RPR serial arm and give up effector as well as a 3RRR planar manipulator as its base.

3. Summary

Depending on the design goal and performance, hybrid manipulators could combine serial and parallel setups. The following two variations are the most workable answers to this issue, which calls for a modular reconfigurable manipulator with generalized operability for this project.

Type I: To create a hybrid serial and parallel mechanism, a 3 DOF planar parallel manipulator might be fixed to this configuration, together with a 3 DOF serial manipulator. (Figure 6).

Type II: In this arrangement, a platform is supported by three serial arms. The platform has six ranges of freedom average thanks to the serial arms' two lively joints and four passive joints. In Figure 7,

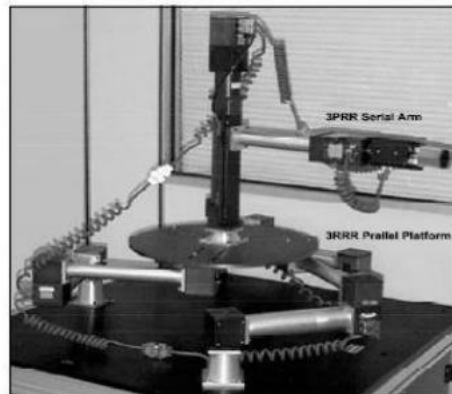


Figure 6: Type I Configuration

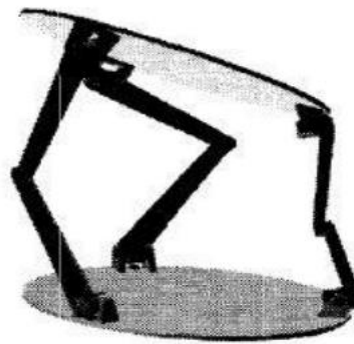


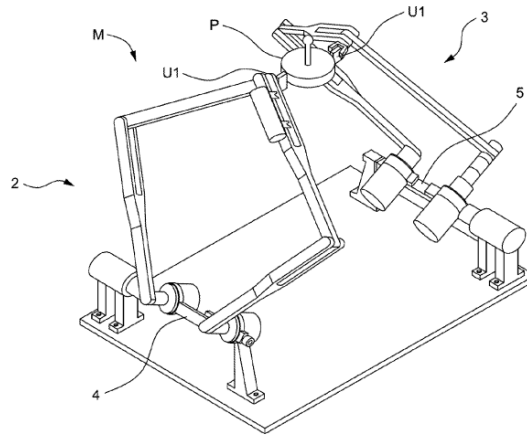
Figure 7: Type II configuration

To hire any of the aforementioned mechanisms, it is essential to optimize factors like stiffness, workspace variety, weight balances, hyperlink collision occasion, and actuator location. The quality distribution of mass and area between the 2 configurations is for the manipulator configuration chosen in this mission. Additionally, fewer linkages need to be used to create a gadget that is lighter and much less liable to linkage collisions. The Type I manipulator gives a better alternate-off than the later due to its lower center of gravity, higher structural rigidity, and computationally easier inverse kinematics after careful evaluation of overall performance traits and kinematic complexity. A three DOF parallel manipulator serves as the basis assist for the proposed hybrid manipulator, which also includes a three RRR articulated serial arm fixed with a favoured quit effector. The serial arm could have a simpler design because the parallel base provides three degrees of freedom (planar). This manipulator could deliver the needed performance. This strategy is beneficial for

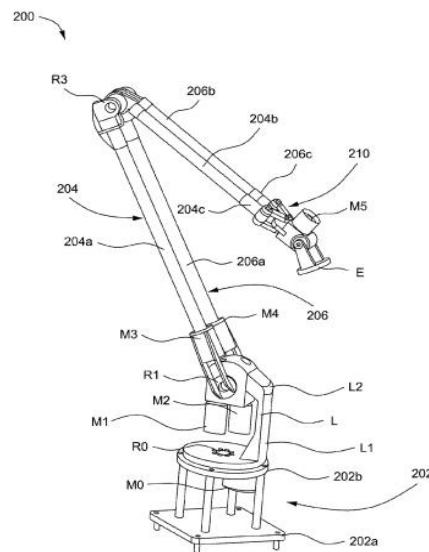
- Design updates and alterations at any project stage.
- Reduce the time needed for design or construction.

- Modify the joint types, actuation strategies, and link lengths.

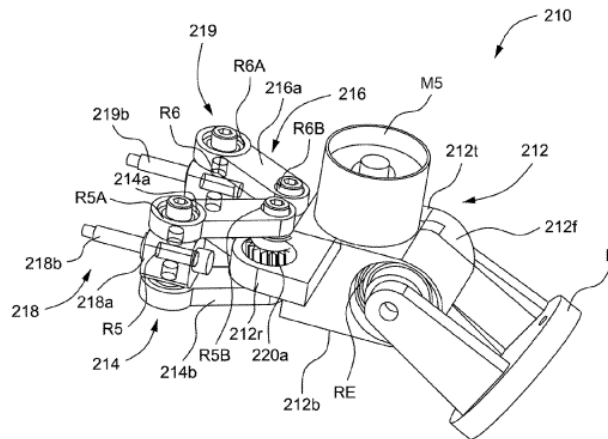
4. DESCRIPTION OF A SIX DEGREES OF FREEDOM HYBRID SERIAL-PARALLEL LINKAGE BASED ROBOTIC MANIPULATOR



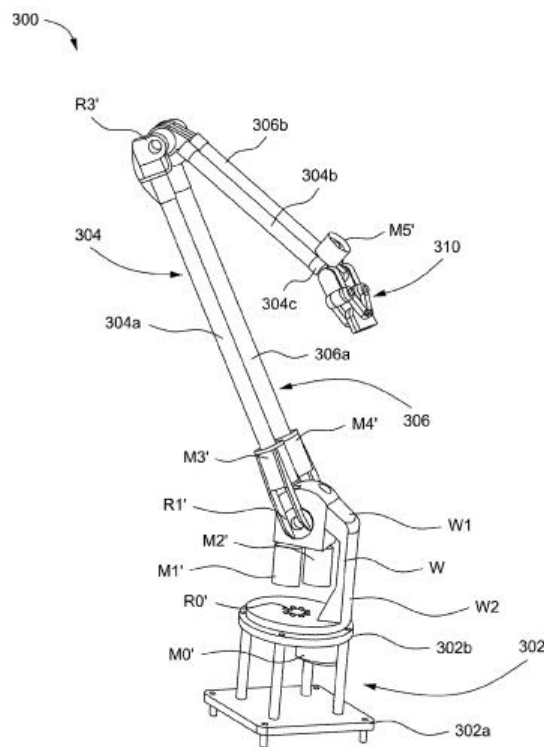
A robotic manipulator is depicted in FIG. 8 according to information found in related art.



A hybrid robotic manipulator that complies with one of the above described embodiments is shown in FIG. 9.



The hybrid robotic manipulator shown in FIG. 9A's wrist section is displayed.



Another example of a hybrid robotic manipulator is shown in FIG. 10.

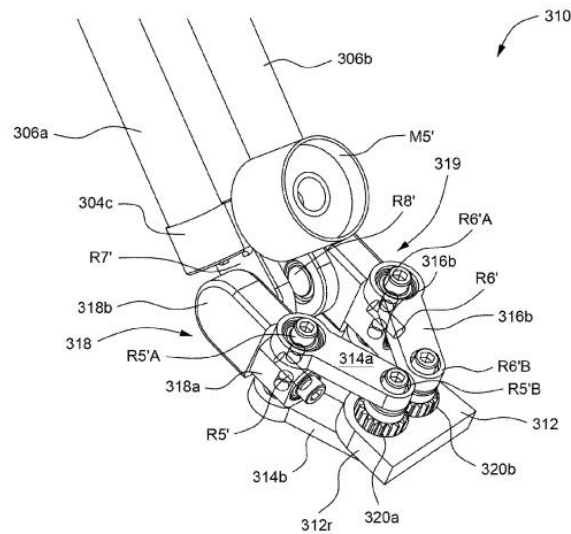


FIG. 10A shows the wrist portion of the hybrid robotic manipulator.

4.1 THE TECHNOLOGY FIELD

This invention relates to robots that can manipulate objects, more particularly, but not exclusively, hybrid robots that do so by combining serial and parallel linkage systems.

4.2 READING IN SUMMARY

The major objective is to build a hybrid robotic manipulator that makes advantage of both parallel and serial communication techniques. Another objective is to develop a hybrid robotic manipulator with a workspace for position comparable to a serial link manipulator and a workspace for orientation akin to the human wrist. Another objective is to develop a hybrid robotic manipulator that can employ smaller, less expensive motors to move its linkages because most of its actuators are located closer to the robot's base.

4.3 DESCRIPTION OF FIGURE IN SUMMARY

As like reference letters/numbers indicate corresponding areas in the various figures, the preceding drawings illustrate this idea. You can better comprehend the embodiments described here by reading the following description with reference to the figures: A robotic manipulator is shown in FIG. 8 according to the related art; a hybrid robotic manipulator is shown in FIG. 9 according to an embodiment disclosed here; a wrist portion of the hybrid robotic manipulator is shown in FIG. 9A; a hybrid robotic manipulator is shown in FIG. 10 according to another embodiment; and a wrist portion of the hybrid robotic manipulator is shown in FIG. 10A;

4. Conclusion

In this study, a brand-new type of hybrid serial-parallel mechanism is introduced, one that combines a pure 3-UPU translational mechanism with a pure 3-UPU spherical rotation mechanism. For real-time applications, this type of serial-parallel mechanism is simple to regulate and can have its motion simplified to pure translation and pure spherical rotation. This hybrid mechanism was initially proposed as a compensating platform in a deep-sea mining system to take into account a ship's heave, rolling, and pitching. The closed-form solution for the direct position problem for the two types of 3-UPU mechanism is shown together with a comprehensive numerical demonstration based on the proposed technique.

Conflict of interest:

There is no conflict of interest.

Data availability statement:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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This study did not receive any funding in any form.

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