

Cable-driven Parallel Robots for Handling Goods of all Sizes

IPAnema 3 platform.

Market requirement

Robot systems are already widely used in production and offer major advantages due to features such as repeatability and the capacity to handle high payloads. Despite the flexibility offered by their kinematics, they still reach their limits. For example, in the construction sector when it comes to large workspaces in combination with high payloads. For this and other reasons, cranes tend to be used to handle large and heavy parts.

Cable robots are capable of performing such tasks automatically, combining the unique advantages of robotic systems with innovative design.

Concept and application

The use of cable-driven parallel robots is a novel concept for automated handling solutions with extreme requirements.

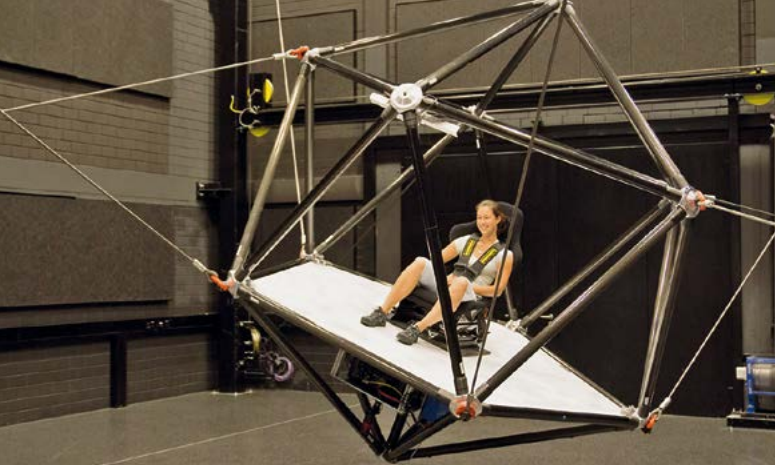
Compared to conventional industrial robots, the Fraunhofer IPA demonstrator IPAnema 3 features:

- a large working space (16 m x 11 m x 6 m)
- depending on configurations, high speeds up to 10 m/s and extreme acceleration $>10\text{ g}$
- the ability to handle payloads up to 250 kg

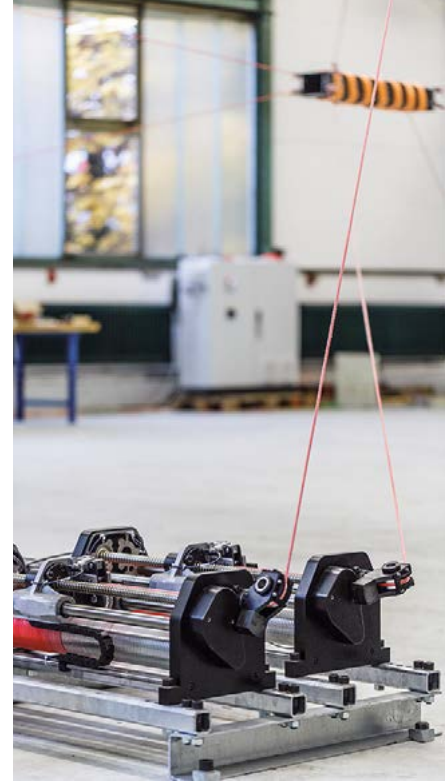
In addition, these features can be adapted to specific cases: The efficient force transmission via the cables allows payloads of several tons per cable; heavy-duty winches can also be used.

IPAnema 3 tool change platform.





Cable-driven robot for flight simulation.



IPAnema 3 winch station developed by Fraunhofer IPA.

The cable robot is controlled by a real-time CNC control system that is easy to program with standard G code (DIN 66025). In semi-automatic mode, an operator can also control the cable robot remotely. A programmable logic controller (PLC) is connected and enables simple integration into existing systems.

Additional ropes can easily be inserted into the cable robot to increase safety against failure of individual components in safety-critical applications, such as lifting heavy and/or sensitive loads. Alternatively, the additional winches can be used to extend the workspace.

The robot itself is simply made up of compact winch units that can be integrated into existing systems. This means that production and handling tasks can still be automated even when space is severely limited.

Possible fields of application and implementation examples

Cable robots have numerous potential uses. These include additive printing processes because workspaces are easily scalable with cable robots. Fraunhofer IPA is also working on research projects concerned with using cable robots to suspend facades in the construction industry.

Another possible field of application is the automation of manufacturing processes. Thanks to their large workspace, cable robots can handle very large parts, such as rotor blades for wind turbines or aircraft fuselages.

A completely new field of application is flight simulation. To this end, Fraunhofer IPA, under the direction of the Max Planck Institute for Biological Cybernetics in Tübingen, has co-developed a new and unique cable robot, which is capable of moving people on a platform. Its design makes it highly versatile and particularly interesting for virtual reality applications: from simulating races or helicopter flights to tiny movements that the human body is only just able to perceive.

Our services

As your project partner, Fraunhofer IPA is at your side with technological know-how from the initial idea to the actual use of a cable robot. Our experts have years of experience in kinematic modeling, simulation and design of this technology.

We offer the following services:

- Feasibility studies using state-of-the-art simulation software and experiments on the IPAnema 3 demonstrator
- Joint analysis of your application and conception of a customized automation solution
- Design and construction of cable robots
- Implementation of prototypes
- Realization and commissioning

Your advantages

Cable robots allow the precise and fast handling of substantial loads quickly and precisely within a large workspace. Extremely short cycle times are possible with small payloads. Cable robots also open up the possibility of automating production and handling tasks, even if these cannot be solved by conventional robots for technical or economic reasons.

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