



Brushless maxon DC motor Moves Humanoid Robotic Hand

There has been rapid advancement in the development of robotic hands to replicate human movement. Delicate grippers with both fingers and thumbs are now a reality. In the near future multi-fingered motor driven robotic hands will be part of the daily workplace. In areas where basic grippers are currently employed there will soon be complex five fingered hands that can carry out far more intricate tasks. Important advancements in mechatronics have enabled the production of multi-fingered hands with separately controllable fingers and joints. The complex mechanics and control electronics that are required to achieve this are now, to a certain extent, standard commercial parts.

The human hand is one of the most intricate structures of nature. Its evolutionary design has been studied by scientists for years and the results of this research are being implemented in the robotic hand of the future. A new robotic hand has been developed by the German Aerospace Centre (DRL in conjunction with the Harbin Institute of Technology (HIT). Micro motor and drive technology together with high-performance communication technology have led to a development that is setting new standards in replicating the human hand. The new DLR-HIT Hand II has five fingers, each with four joints and three degrees of freedom and it is small and light. Four fingers are required for clasping conical parts, and a thumb is used as an outer support. The full mechanical range of movement must be controlled and monitored to enable the hand to be used fully. A High-performance BUS system is critical.

The high speed bus controlling the DC motors.

The DC motors in the DRL-HIT Hand II are installed inside the fingers. This means that close attention has to be given to the control processor's information with positioning and operation data. This is the only way that the discrete DC drive can show all its ability in the application. Each finger joint is fitted with a non-contacting angle indicator and a torque transducer. Both sensors need very high accuracy and resolution. Rapid feedback for comparing target and actual value is crucial for correct operation when performing precise and delicate tasks. This results in high volumes of data and high baud rate requirements.

For this an internal real-time 25Mbps bus system was developed especially for the application Based on Field Programmable Gate Arrays (FPGA's), only three leads are required for the serial connection of the hand with the control processor. The controls are a signal processor on a PCI insert card, integrated with a standard PC. The hand can be easily controlled at the PC via a user-friendly interface with all sensor data displayed on the screen.

maxon flat DC motors.

Each finger needs several DC motors that can all be independently controlled. 15 brushless DC motors with Hall sensors are used in each hand. maxon motor's 20mm brushless flat motors meet several key necessities, they are inexpensive, commercially available products with a high power density in a compact design. The motors, including Hall sensors are only 10.4mm long with a diameter of 21.2mm and each motor weighs only 15g. They are coupled with harmonic drive gears for backlash free operation. The Small DC motors are available in a 12 or 24 V version and provide a torque of 8.04 mNm. Dynamic characteristics and preloaded ball bearings give precise response behaviour of control commands.

Given the new highly compact motor technology with high resolution feedback and rapid data transfer, the new DLR-HIT Hand II can be controlled very sensitively and precisely. The system micromechanics and microelectronics complement each other perfectly.

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Brushless DC flat servo motor.

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