

CAN-FD-based testing solution for robotic dexterous hands

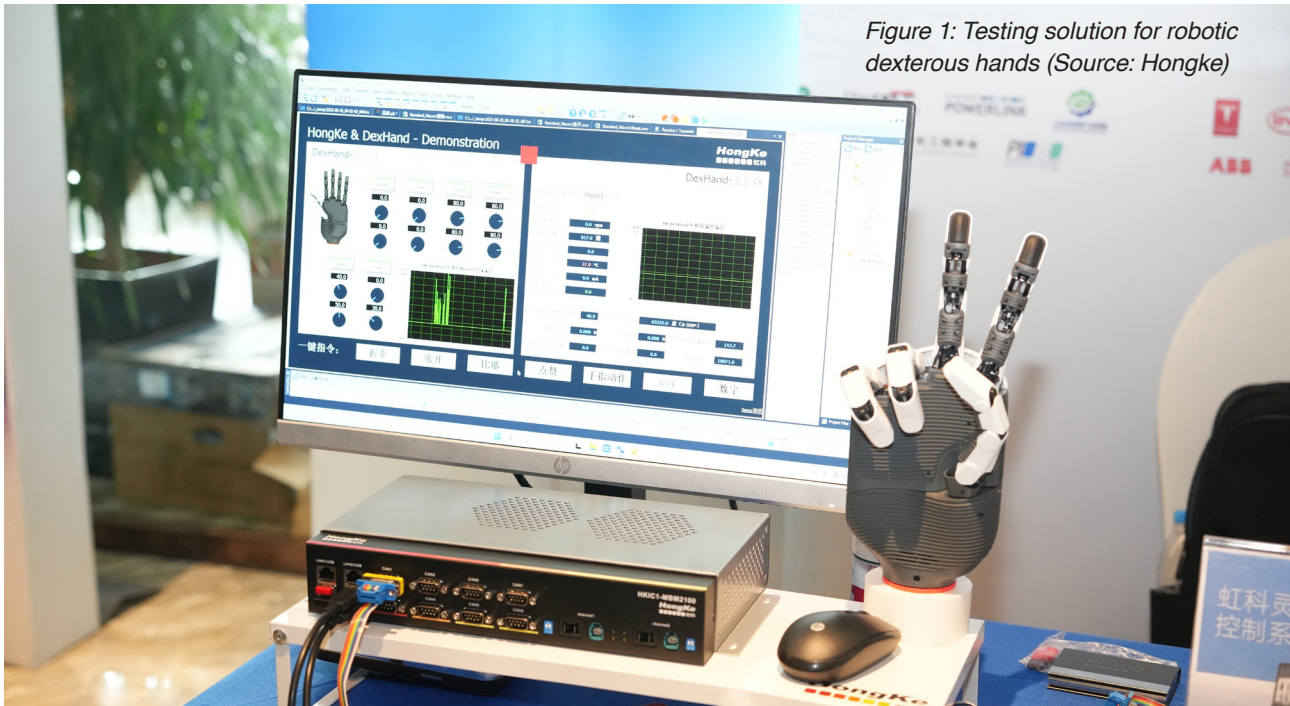


Figure 1: Testing solution for robotic dexterous hands (Source: Hongke)

Hongke (China) has developed a testing solution for robotic dexterous hands including the full process verification from communication to control. The company works mainly in the automotive industry and also acts as a distributor of Peak and other CiA members e.g., in China, Japan, and South Korea.

In the R&D and industrialization of robotic dexterous hands, accurate testing and efficient verification are core issues to ensure product reliability. This article describes a solution composed of a CAN FD testing tool suite and a high-performance dexterous hand. The solution integrates high-speed communication, monitoring, and control technologies to support the R&D, quality inspection, and application of dexterous hands.

CAN FD integration

As the core executive component of humanoid robots, robotic dexterous hands need to have multi-degree-of-freedom (DOF) movement, force sensing, and precise operation capabilities. Their application scenarios cover industrial sorting, medical rehabilitation, scientific research experiments, and other fields. For such applications it is required to achieve precise testing of dexterous hands with millimeter-level movement and millinewton-level force control.

In the communication control of the robotics industry, either Ethercat or CAN FD is basically selected as the core communication network. Among them, CAN FD stands out due to its stable transmission quality and low wiring cost. As an upgraded version of CAN CC (classic), CAN FD

increases the data phase transmission rate to up to 8 Mbit/s and expands the single-frame data payload to 64 bytes, while retaining the high reliability and real-time advantages of the CAN CC network. Thus, it meets the needs of robotic dexterous hands for high-speed command transmission and multi-sensor data feedback.

Core solution

The testing solution realizes a full-link technical verification of dexterous hands from the signal collection to motion execution. The solution consists of:

- ◆ Dexterous hand unit: Equipped with multi-DOF (e.g., 19 DOF), high-precision force/position sensors, and a bionic structural design, it can reproduce anthropomorphic movements and precise operations.
- ◆ CAN FD testing tool: Hongke Bus Workstation, which adapts to the dexterous hand's transmission rate of 1 Mbit/s for the arbitration phase and 5 Mbit/s for the data phase, with a single-frame payload of 64 byte and a timestamp accuracy of 1 μ s. It provides a hardware foundation for high-speed command issuance and real-time data feedback.

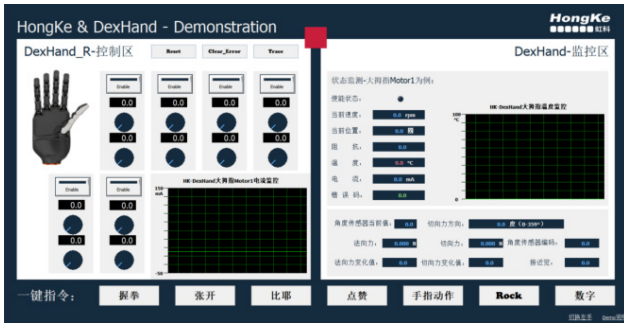


Figure 2: The software can independently monitor motor status and sensor data of the left and right hand respectively (Source: Hongke)

- ◆ Software platform: Customized empowerment by PCAN-Explorer 6 with:
 - Signal monitoring: The software real-time collects and parses multi-dimensional signals of the dexterous hand (e.g., motor current, temperature, angle sensors, and force sensors) and presents them in the form of charts (see Figure 2). The software can independently monitor motor status and sensor data of the left and right hand respectively.
 - Command sending: Supports one-click movement command sending for key gesture actions, and can also realize fine motion control of single or multiple joints via a parameterized interface. The measured delay deviation is less than 5 μ s, meeting the synchronization requirements of the mN-level force control.
 - Data parsing and analysis: With the help of data-base file parsing function, it converts raw data on the CAN FD network into human-understandable physical quantities, and supports data recording, offline analysis, and fault tracing (see Figure 3).

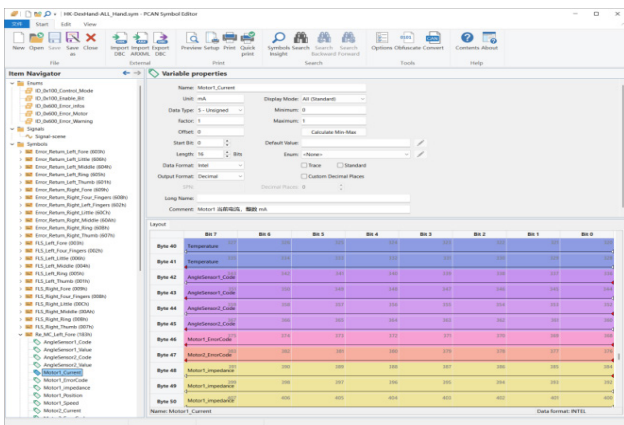


Figure 3: Data parsing and analysis window (Source: Hongke)

System deployment

As shown in Figure 1, the entire system consists of a dexterous hand, a Hongke Bus Workstation, and a host computer (running the customized PCAN-Explorer 6 project). After the hardware connection is completed, the CAN FD communication parameters (such as bit rate, communication data, etc.) are set through the "Bus Configuration" module

of PCAN-Explorer 6, and a high-speed communication link between the dexterous hand and the testing tool can be established.

In the Symbol Editor software of PCAN-Explorer 6, one can create a communication data base based on CAN/CAN FD networks, including descriptions and layouts of specific messages and signals on the network, as well as virtual variables or various data type parameters that may be used in some customized projects. By loading the data-base file, in the customized project, one can shift from the OSI data link layer to the OSI application layer. Even non-technical personnel can complete basic communication testing and command driving through this set of customized projects:

- ◆ Motor status monitoring: Real-time view of the speed, position, current, temperature, and other parameters of each joint motor to ensure the motor operates within safe thresholds.
 - ◆ Sensor data monitoring: Parse the outputs of angle sensors and force sensors (normal force, tangential force) to verify the pose accuracy and force control performance of the dexterous hand during movement.
 - ◆ Communication status monitoring: Real-time track the load rate, error frames, and other information of the CAN FD network to ensure the stability of the communication link.
- The CAN-FD-based robotic dexterous hand testing solution relies on the collaboration between the Hongke Bus Workstation tool and PCAN-Explorer 6 software. It provides quantitative support for the technical iteration of dexterous hands and serves as a technical benchmark for the standardized development of the robotics industry. It promotes the transformation of dexterous hands from laboratory prototypes to mass-products used in such applications as industrial sorting and medical rehabilitation, etc. ◀

CAN FD testing tool

The Hongke Bus Workstation is an industrial computer motherboard specifically designed for vehicle network communication. It is used for monitoring, simulating, and emulating CAN-(FD)-based and T1 network messages. The workstation integrates eight CAN/CAN FD channels and two 1000Base-T1 interfaces, and is compatible with PCAN low-level drivers. It can meet the testing and data transmission requirements in complex vehicle network environments, and is widely applied in automotive R&D, intelligent transportation, vehicle testing and other fields.



Hongke Bus Workstation (Source: Hongke)



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