

## 中国有色金属 China Non-ferrous Metals

### 机器人专题系列（八）：控制器——机器人的大脑

### Special Theme on Humanoid Robots (VIII): Controller--the brain of robots

观点聚焦 Investment Focus

股票名称	评级	股票名称	评级
紫金矿业	Outperform	锡业股份	Outperform
赣锋锂业	Outperform	驰宏锌锗	Outperform
天齐锂业	Outperform	赤峰黄金	Outperform
华友钴业	Outperform	银泰黄金	Outperform
洛阳钼业	Outperform	盛屯矿业	Outperform
山东黄金	Outperform	立中集团	Outperform
天华超净	Outperform	博威合金	Outperform
格林美	Outperform	安宁股份	Outperform
石英股份	Outperform	万丰奥威	Outperform
南山铝业	Outperform	宁波韵升	Outperform
横店东磁	Outperform	甬金股份	Outperform
中矿资源	Outperform	贵研铂业	Outperform
铜陵有色	Outperform	鑫铂股份	Outperform
川能动力	Outperform	盛达资源	Outperform
神火股份	Outperform	盛达资源	Outperform
金力永磁	Outperform		

资料来源: Factset, HTI

(Please see APPENDIX 1 for English summary)

本专题系列报告聚焦于机器人领域，旨在介绍机器人核心零部件——控制器的特征及功能，并分析当前市场的竞争格局。

**机器人的控制器是接收来自传感器的检测信号完成指令任务的装置。**机器人的控制方式包括运动控制和力控制。运动控制主要控制机器人的位置；力控制则控制机器人末端执行器的作用力与力矩。目前控制器主要采用 PC-Based 控制，通过控制器传达命令来控制机器人的运动位置和路径。

**机器人控制器市场国外主导高端市场，国内加速布局。**国外控制器龙头企业发那科、库卡和 ABB 共占据国内市场份额的 45%，而国内尚未形成相当的市场竞争力。国内外控制器的差距主要体现在控制器算法的开发与不断优化层面。国外先发的行业发展优势使得其收到客户问题反馈并进行算法迭代优化较迅速与成熟。而国内仍需提高品牌知名度、提高技术，来打破外资主导的竞争格局。

## 1. 控制器综述

机器人的控制器是接收来自传感器的检测信号完成指令任务的装置。机器人的控制方式包括运动控制和力控制。运动控制主要控制机器人的位置；力控制则控制机器人末端执行器的作用力与力矩，通过控制器来控制机器人的运动位置和路径。

机器人控制系统的成本占比为 12%，控制器多为机器人原厂商自行制作，行业格局国外占有主要竞争优势。目前，机器人控制系统主要厂商有发那科、库卡、ABB、安川等，2020 年全球市占率分别为 16%、14%、12%、11%。国内研发控制器的企业主要有埃斯顿、固高科技、众为兴等。

表 1 机器人控制器行业主要参与者

控制器主要参与者	
国内	埃斯顿，固高科技，众为兴，汇川科技，英威腾，雷赛智能，维宏电子
国外	ABB，发那科，库卡，安川，KEBA，贝加莱，倍福，泰道

资料来源：亿欧智库，海通国际

## 2. 控制器分类及区别

控制器控制机器人运动主要分为 PLC、嵌入式和 PC-based 三种技术路径。其中 PC-based 运动控制器是通用运动控制器的一种类型，具有系统通用性强、可拓展性好、能够满足复杂运动的算法要求、抗干扰能力和开放性强等特点。因此 PC-based 技术具有广阔的替代性，正逐渐替代前两种技术，是日后发展的主要方向。

表 2 主要控制器分类

分类	特点	应用领域
PLC 控制器	系统简单，体积小，可靠性高，但不支持复杂算法，可以通过在 PLC 平台上，添加驱动步进电机或伺服电机的位置控制模块，在为各种机械设备提供逻辑控制的同时，提供运动控制功能	可以用于圆周运动或直线运动的控制，广泛应用于各种机械、机床、机器人和电梯等行业
嵌入式控制器	涵盖从简单到复杂的各种运用，具有应用灵活、稳定性高、定制性强、价格便宜、操作和维护方便的特点	在针织机械、激光、切割、点胶机等设备制造行业有广泛的应用
PC-Based 控制卡	系统通用性强、可拓展性强，能够满足复杂运动的算法要求、抗干扰能力强，可供用户根据不同的需求，在 DOS 或 Windows 等平台下自行开发应用软件，组成各种控制系统	主要应用于电子、半导体、工业机器人、包装等领域

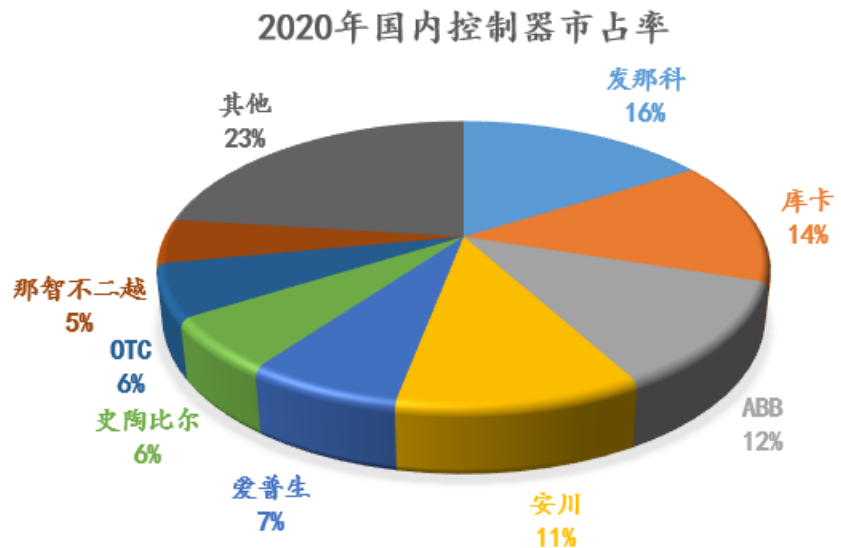
资料来源：雷赛智能招股书，海通国际

按控制器分类，西门子是 PLC 控制器市场龙头。在国内的 PC-Based 控制卡市场，高端市场由美国泰道、翠欧等外资主导，但国内品牌正逐渐发力，台湾研华和固高科技在 2019 年国内市占率分别为 16%和 13%。

### 3. 控制器市场特点

机器人控制器市场国外主导高端市场，国内加速布局。国外控制器龙头企业四大家族发那科、库卡、ABB 和安川在 2020 年共占据国内市场份额的 53%，而国内尚未形成相当的市场竞争力。目前，控制器参与者主要分为机器人主体厂商自制自用和专门生产控制器，单独售卖两种类型，其中行业龙头公司主要采用自制自用类型，如发那科、ABB 和埃斯顿等，且此类型控制器无法适配其他机型，故机器人控制器的市场份额近似机器人主体的市场份额占比。

图1 2020 年国内控制器市占率



资料来源：埃夫特招股书，海通国际

国内外控制器的差距主要体现于软件算法开发。通过分析本田 ASIMO、波士顿、欧洲 iCUB 和 POPPY 等龙头人形机器人的控制器配置，控制器的芯片本身不存在较大技术壁垒，主要差距体现在控制器算法的开发与不断优化层面。国外领先的行业发展优势使得其收到客户问题反馈并进行算法迭代优化较迅速与成熟。而国内仍需提高品牌知名度、提高技术，来打破外资主导的竞争格局。

**APPENDIX 1****Summary**

The controller of the robot is a device that receives the detection signal from the sensor to complete the command task. The control mode of robot includes motion control and force control. Motion control mainly controls the position of the work robot; Force control controls the force and torque of the end effector of the robot. At present, the controller mainly adopts PC Based control, which transmits commands to control the motion position and path of the robot.

The robot controller market is dominated by the high-end market abroad, and the layout is accelerated at home. Foreign leading controller enterprises Fanuc, Kuka and ABB account for 45% of the domestic market share, while the domestic market has not yet formed considerable competitiveness. The gap between domestic and foreign controllers is mainly reflected in the development and continuous optimization of controller algorithms. The development advantage of foreign first mover industry makes it more rapid and mature to receive customer problem feedback and perform algorithm iteration optimization. However, domestic enterprises still need to improve brand awareness and technology to break the competition pattern dominated by foreign capital.

## 附录 APPENDIX

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**优于大市**，未来 12-18 个月内预期相对基准指数涨幅在 10%以上，基准定义如下

**中性**，未来 12-18 个月内预期相对基准指数变化不大，基准定义如下。根据 FINRA/NYSE 的评级分布规则，我们会将中性评级划入持有这一类别。

**弱于大市**，未来 12-18 个月内预期相对基准指数跌幅在 10%以上，基准定义如下

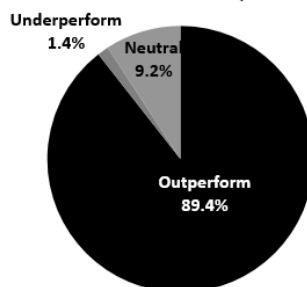
各地股票基准指数：日本 – TOPIX, 韩国 – KOSPI, 台湾 – TAIEX, 印度 – Nifty100, 美国 – SP500; 其他所有中国概念股 – MSCI China.

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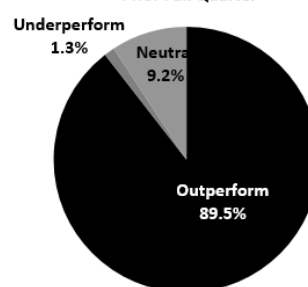
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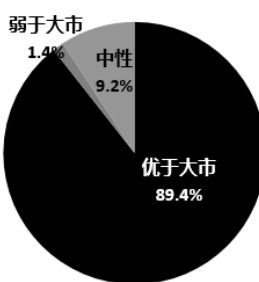
Most Recent Full Quarter



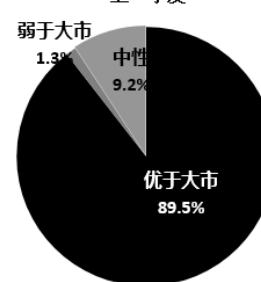
Prior Full Quarter



最新季度



上一季度



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**Outperform:** The stock's total return over the next 12-18 months is expected to exceed the return of its relevant broad market benchmark, as indicated below.

**Neutral:** The stock's total return over the next 12-18 months is expected to be in line with the return of its relevant broad market benchmark, as indicated below. For purposes only of FINRA/NYSE ratings distribution rules, our Neutral rating falls into a hold rating category.

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**Benchmarks for each stock's listed region are as follows: Japan – TOPIX, Korea – KOSPI, Taiwan – TAIEX, India – Nifty100, US – SP500; for all other China-concept stocks – MSCI China.**

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\*在每个评级类别里投资银行客户所占的百分比。

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中性，未来 12-18 个月内预期相对基准指数变化不大，基准定义如下。根据 FINRA/NYSE 的评级分布规则，我们会将中性评级划入持有这一类别。

卖出，未来 12-18 个月内预期相对基准指数跌幅在 10%以上，基准定义如下

各地股票基准指数：日本 – TOPIX, 韩国 – KOSPI, 台湾 – TAIEX, 印度 – Nifty100; 其他所有中国概念股 – MSCI China.

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IB clients*	5.5%	6.8%	4.5%

\*Percentage of investment banking clients in each rating category.

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