# 2024世界机器人大会
# 2024 World Robot Conference

# 人形机器人十大趋势展望
# 10 Trends of Humanoid Robots

# 1 人形机器人专属部组件与材料

## Exclusive Components and Materials for Humanoid Robots

- 高爆发电机、高算力芯片、精密减速器、高精度传感器、长续航电池等核心零部件，将构筑起更加稳定、高性能的人形机器人硬件系统

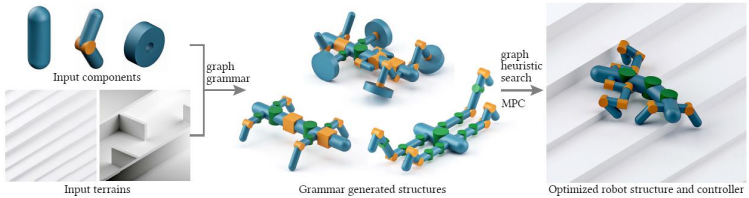
**High-explosion motors, high-computing power chips, high-precision reducers and sensors, and long-endurance batteries**, will construct a more stable and high-performance hardware system for humanoid robots.

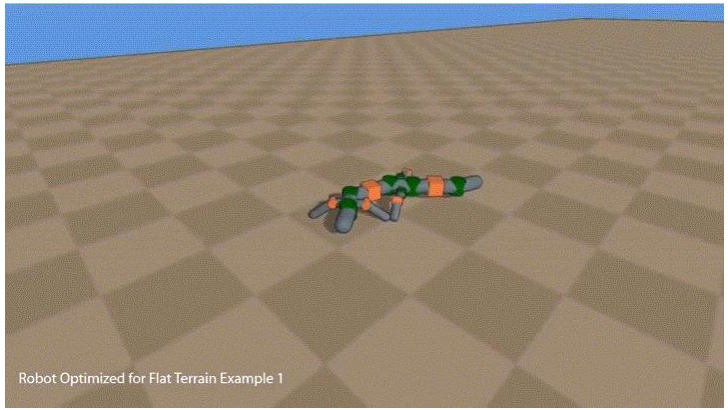
# 2 人工智能赋能人形机器人设计

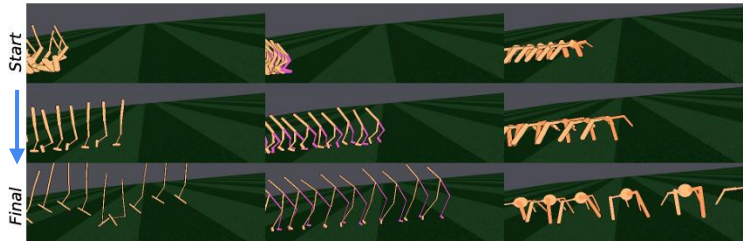
## AI for Design of Humanoid Robots

- **基于神经网络、图语法、进化算法等人工智能技术，将能够根据场景和任务需求，自动构建人形机器人的腿足、手臂、躯干等模块，实现形态和控制的协同优化**

Based on technologies of artificial intelligence such as neural networks, graph grammars and evolutionary algorithms, it would be possible to automatically construct modules of humanoid robots such as legs, arms and torso according to the requirements of the scene and tasks, which will achieve a synergistic optimization of form and control.



# 3 人形机器人运动智能

## Motion Intelligence of Humanoid Robots

- **复杂地形行走**：有望适应为人类搭建的斜坡、阶梯、门槛等复杂地形和狭窄环境，实现稳定、自适应、抗干扰的行走

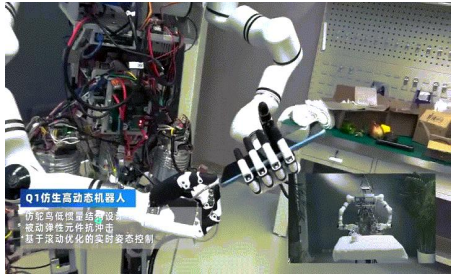
**Walking on Complex Terrains:** Humanoid robots are expected to adapt to complex terrains and narrow environments built for humans, such as slopes, steps and thresholds, achieving stable, adaptive, and anti-interference walking.

- **双臂协同操作**：在下半身抖动的情况下，将通过双臂协作，使用人类的工具和装备，完成高性能操作任务

**Cooperative Operation of Dual-arm:** In the case of unstable lower body, humanoid robots are expected to complete high-performance operation tasks with collaborative dual-arm using human tools and equipment.

- **“软补硬”技术**：在硬件性能欠佳和传感信息匮乏时，将通过软补硬技术系统寻找和充分利用环境和信息约束，弥补硬件的不足，实现高水准的任务执行

**Compensation for Hardware with Software:** When the hardware performance of humanoid robots is subpar and the sensory information is lacking, this technology systematically seeks and fully utilizes environmental and information constraints to compensate for the performance of hardware, achieving high-level task execution.

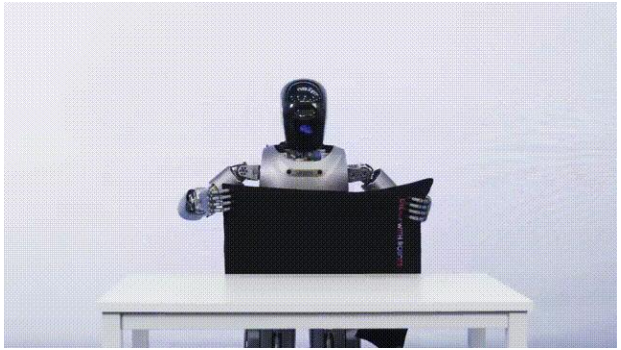


# 4 人形机器人多模态大模型

## Multimodal Large Model for Humanoid Robots

- **将能够通过融合语音、图像、文本、传感信号、3D点云等多模态信息，为人形机器人的感认知和决策规划提供了更强的多模态理解、生成和关联能力，提升在复杂场景任务中的泛化能力**

Multimodal Large Model will enable the integration of multimodal information such as voice, images, text, sensor signals, and 3D point clouds, providing **humanoid robots with enhanced multimodal understanding, generation**, and **association** capabilities for perception, cognition, and decision-making. It will also improve their **generalization** ability in complex scenarios and tasks.

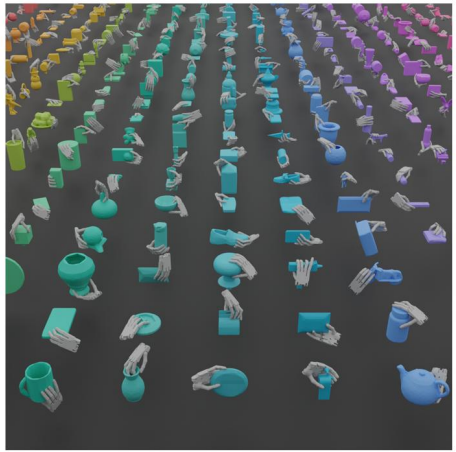



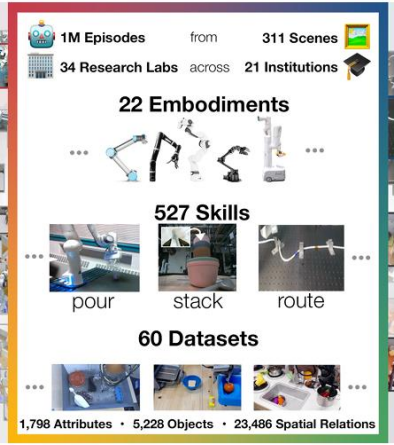
# 5 人形机器人大规模数据集

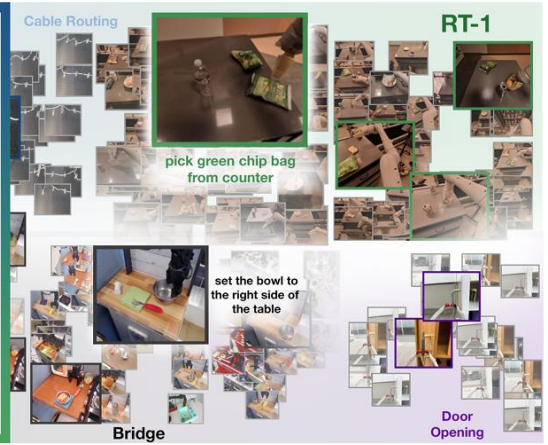
## Large-Scale Dataset for Humanoid Robots

- **基于仿真合成或实体机器人采集，构建大规模、标准化的人形机器人数据集，有利于提高人形机器人本体设计、仿真训练和算法迁移的能力**

  Constructing **large-scale, standardized datasets for humanoid robots** based on data collected from simulation synthesis or physical robots is beneficial for enhancing the capabilities of body design, training in simulation, and algorithm transfer for humanoid robots.




**仿真合成数据集**

Dataset from Simulations

**实体机器人数据集**

Dataset from Physical Robots