IMD: Institute of Media and Design

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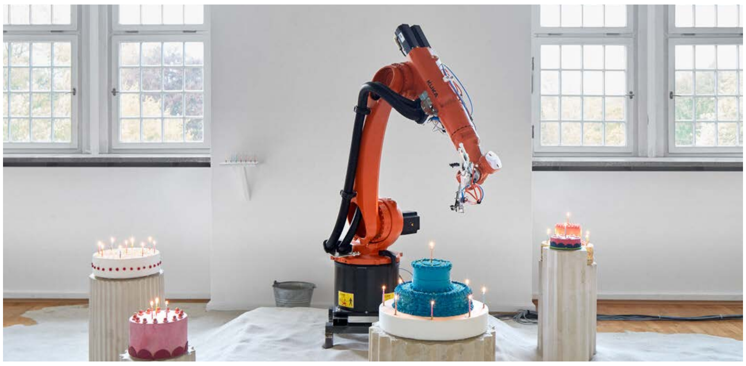
Stegreif, WiSe 2022
Creative Applications for Robotics



Candle Robot

2019
Malte Bartsch, Benjamin Maus

An industrial robot perpetually celebrates its birthday by putting small candles on cakes, lighting themwith a lighter and then blowing them out.

Source: allesblinkt

Digital fabrication has found its place within art, design and architecture in the last two decades. One of the newest developments in the field is the application of robotics. Though robots have been common in industrial manufacturing and assembly, the realization that they might also be useful in architecture is more recent.
The main characteristic that sets robot arms apart from other machines for digital fabrication is the fact that it in facts has no specific set function. It is a machine built to move freely in space, capable of lifting and pushing weight but it depends on the user to define its function. A laser-cutter or a CNC-mill in contrast have set functions; cutting using concentrated light and milling, respectively.

Other advantages of robotic fabrication include speed, precision and efficiency. The capability of repeating a task thousands of times always with the same accuracy or even a thousand different tasks always with precision. This means that they fit right in in the industrial sector and within capitalistic logics.

There is however, potential for robotics to be subverted within design and architecture too. To collaborate with human, to play and perform, to discuss themes of laziness and failure and for artistic expression.

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In the following assignment, we ask you to imagine what robotics can realize in terms of making, playing and performing followed by the development of a custom-tool for the task.

The final outcome should be a physical prototype of a tool to be attached to a robot, photographic documentation and visualizations of its use.

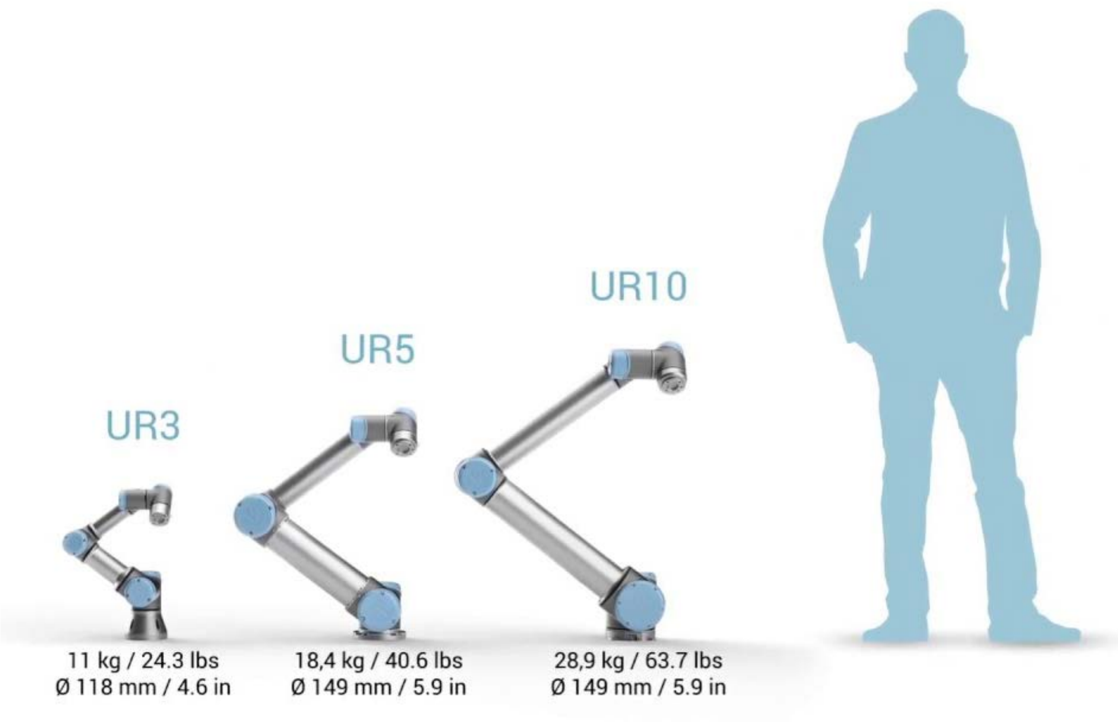
The robot arm

IMD disposes of two Universal Robot robotic arms. A UR10 with a payload of 10kg (can lift or push up to 10kg at the end of the arm) and a UR5 with a payload of 10kg (can lift or push up to 5kg at the end of the arm). They can reach as far as 1300mm and 850mm away from their base respectively.

These are 6 axis robotic arms which means they have 6 joints which can move independently. Think about it like the joints you have in the shoulder, elbow, wrist with two additional joints at the wrist and a rotating base. The base can be mounted on a table, on a wall or even on the ceiling.

With the right calibration and depending on the payload UR robots can have up to 0.1mm accuracy and move at up to 1m/sec.

Video of UR10 in action (in this case set up on a linear rail)

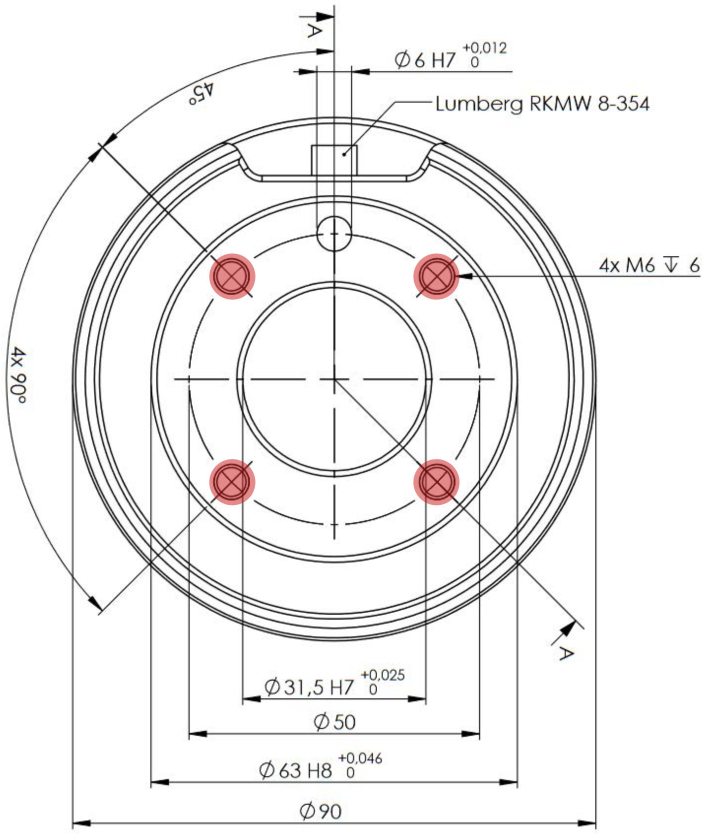


Source: Red Pike

The end-effector

An end-effector is nothing more than the tool attached to the end of the robot arm so that it can perform tasks. It can be as simple as an attachment for a paintbrush or as complex as a remotely controlled 3D printer setup.

The most common way of attaching a tool to a robot is using the four holes for at the end of the robot for M6 screws (dimensions shown below)



Dimensions of the end-flange of a UR robot. Highlighted are the placement of holes for atttachment with M6 screws.
Source: UR10 User Manual

Example of end effector for cutting clay. Note the 4 holes at the botom for attachment with screws. These correspond to dimensions on the left.

Task Description

1. DESIGN AN END-EFFECTOR

- Think of a novel funcion to be performed by robots.W
- What function will the robot perform? In what context?
- Is it for manufacturing, assembly, play or performance? Will it interact with humans or with another robot or work alone?
- What end-effector is needed to perform it?
- Function must be different from the functions shown in the examples and listed references. Be creative! Imagine what a robot can do beyond any of the more obvious tasks.

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2. BUILD PROTOTYPE

- 1:1 scale
- Maximum 5kg
- Use easily available materials
- Include holes for attachment to the robot (see dimensions above)

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3. DOCUMENT OUTCOME

Text:
Short description of function to be performed, relevance of function as a robotic act and design of end-effector.
PDF format // 200 words maximum //

Photographic documentation of prototype:
2 frontal views (90° to each other)
2 views across the corner (45° related to frontal views)
2 perspectives above corner (views above corner, but approx. 30° to horizon from above)
PNG format // All photos in best quality (at least 2000px x 2000px), edited as series (same colour values, high photographic quality, no unedited mobile phone snapshots) //

Illustrations:
1 main atmospheric illustration showing robot(s) performing function with attached end-effector
1 line diagram of end-effector explaining characteristics of the design
PNG format // minimum resolution of 1920 x 1080 //

Submission Details

DIGITAL SUBMISSION

Deadline Montag 05.12.2022 at 17:00Uhr

- Text
- Photos
- Illustrations

ZIP-format containing all files named:
NACHNAME VORNAME MATRIKELNUMMER.zip

Uploaded to https://cloud.tu-braunschweig.de/s/Z8ZjKcscb47wMmC

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ANALOG SUBMISSION

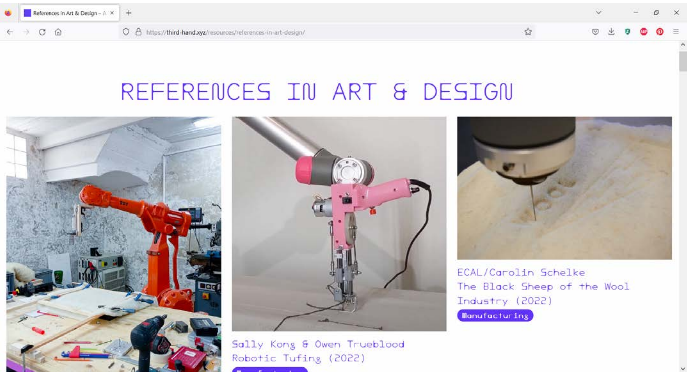
Deadline Mittwoch 07.12.2022 from 09:00 to 12:00Uhr

- End-effector prototype

The prototypes can be handed in at the secretariat of the Institute of Media and Design, Zimmerstraße 24, from 9:00 to 12:00 Uhr.

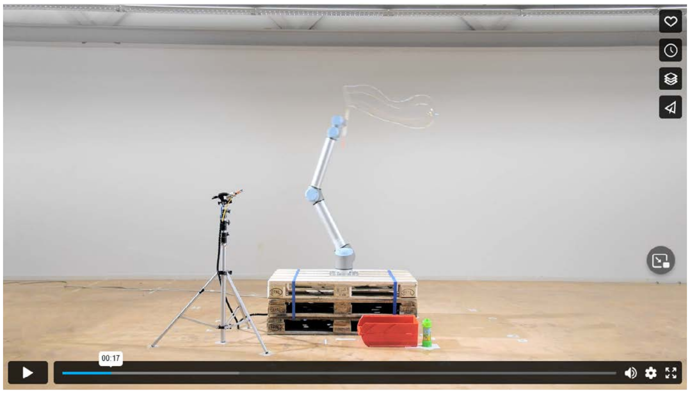
References

THIRD HAND: REFERENCES IN ART AND DESIGN



https://third-hand.xyz/resources/references-in-art-design/

THE CENTER FOR COUNTER PRODUCTIVE ROBOTICS

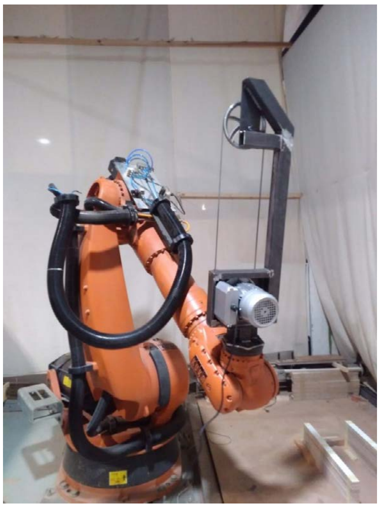


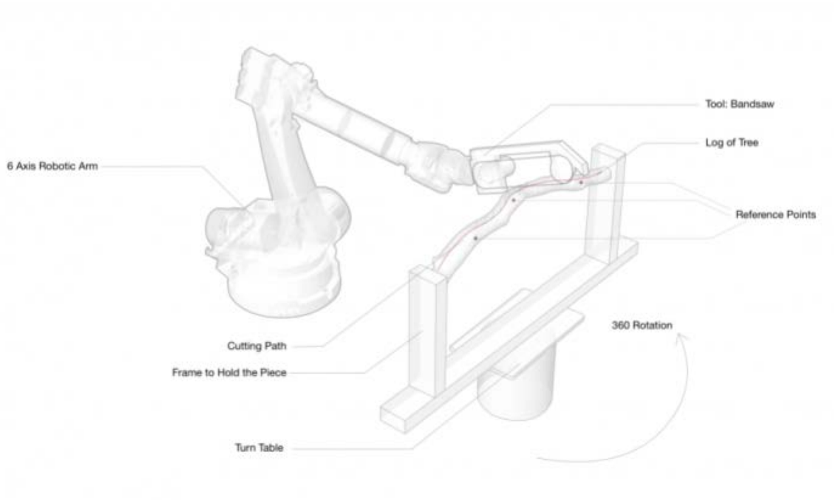
https://vimeo.com/302242239

Further References_Manufacturing and Assembly

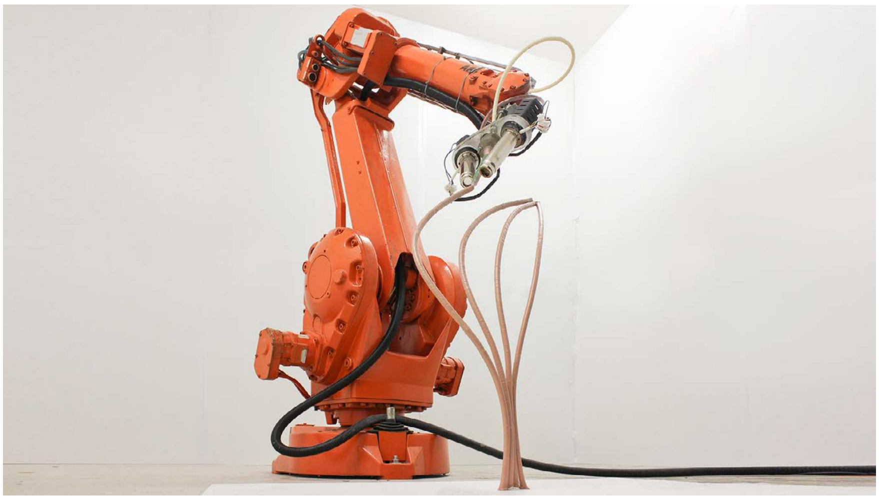
Click on sources for videos of the projects!

Function: custom curved lumber cuts
End-effector: Bandsaw attachment
Source: [IAAC]

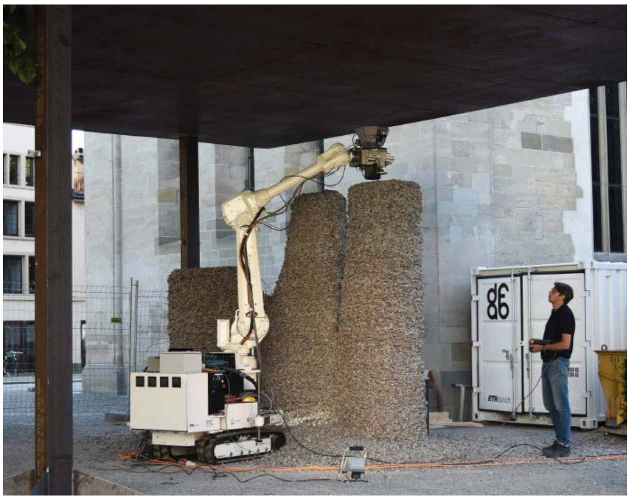




Function: anti-gravity object modelling
End-effector: Two-component resin extruder
Source: [Maeterial]

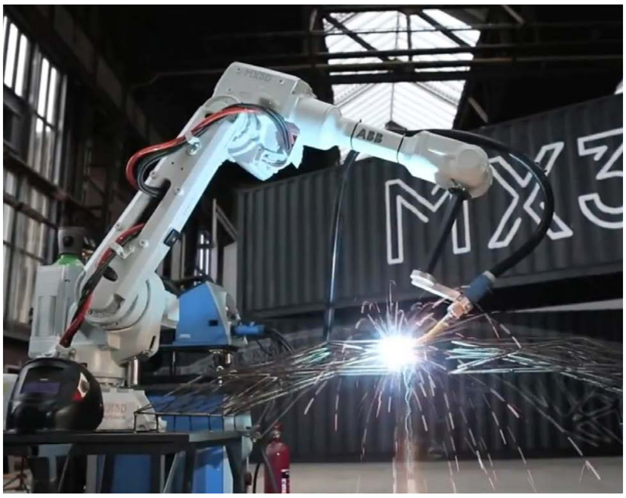


Function: anti-gravity object modelling
End-effector: custom string layer and rock sieve
Source: [ETH]

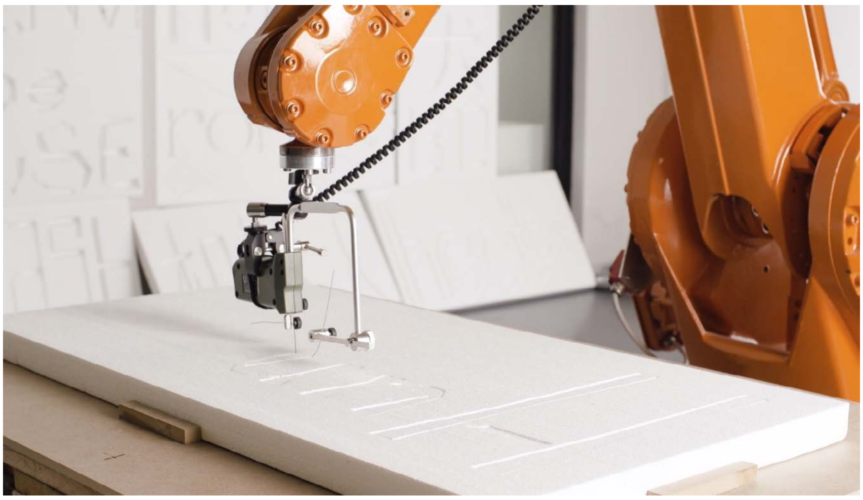


Function: sculpting clay
End-effector: bent metal sheet mounted on wooden adapter
Source: [IAAC]

Function: 3D printing steel
End-effector: welding rod and metal extruder
Source: [MX3D]



Function: sculpting styrofoam
End-effector: hot wire cutter
Source: [AATB]



Further References_Performance and Play

Click on sources for videos of the projects!

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Function: swinging rope for jumpers
End-effector: rope holder
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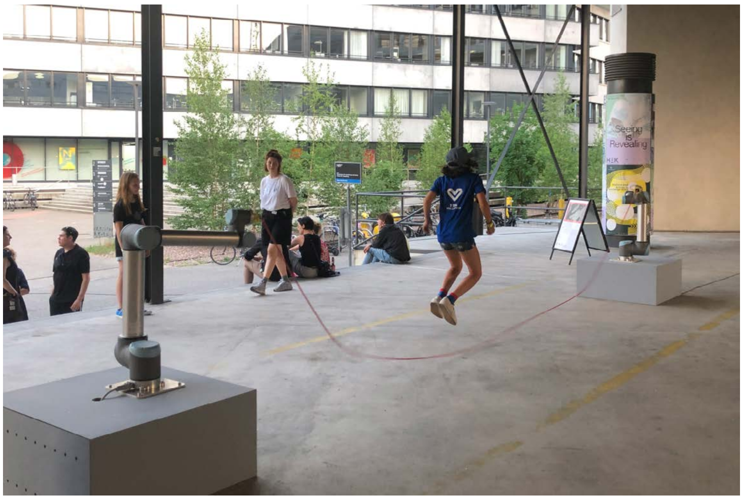
Source: [AATB]



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Function: shaking hands
End-effector: oversized fabric and foam representations of hands
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Source: [AATB]

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Function: blowing bubbles
End-effector: wire soap frame
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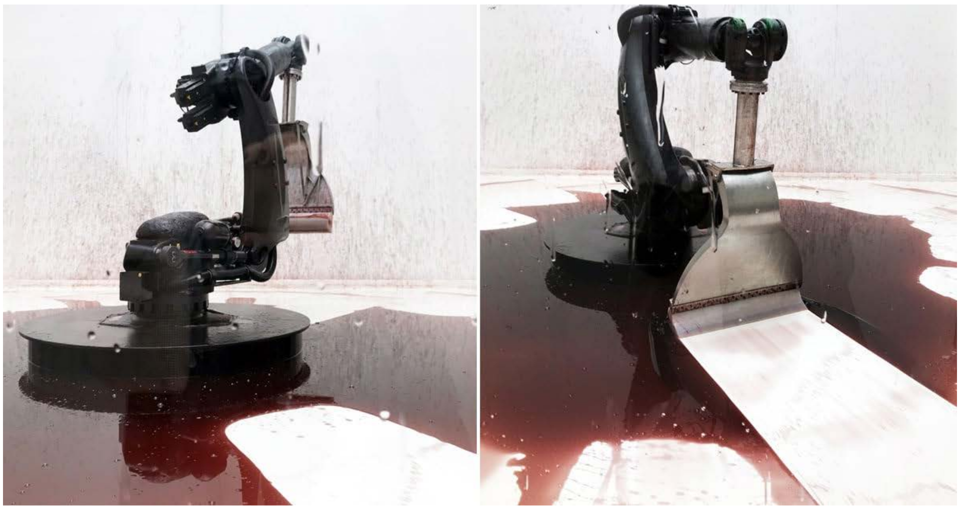
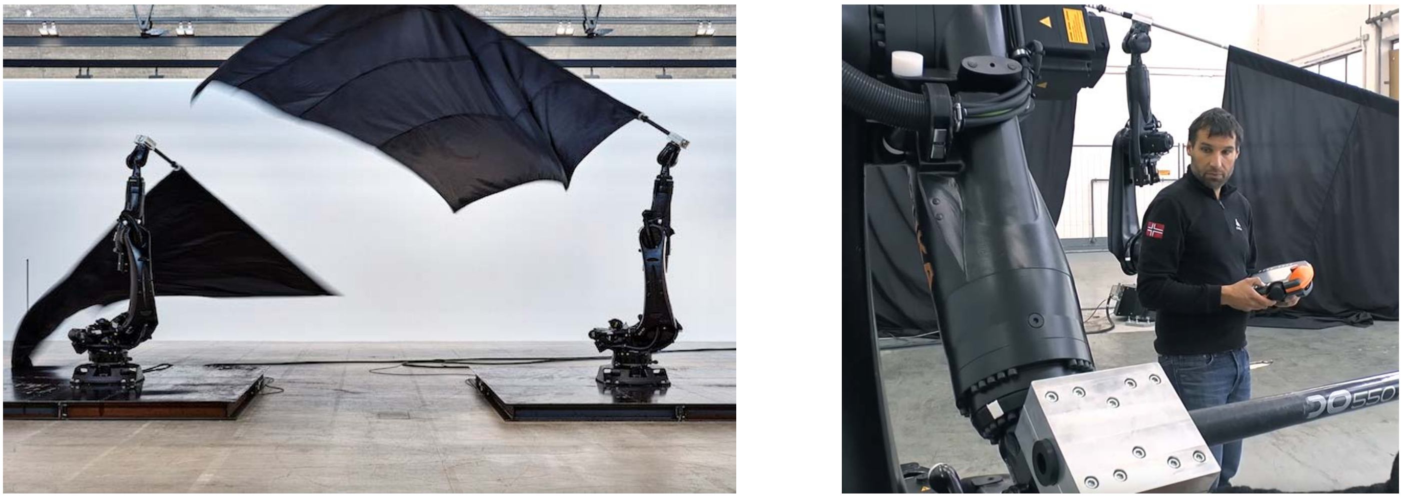
Source: [AATB]

Function: mopping liquid
End-effector: stainless steel and rubber mop
Source: Sun Yuan and Peng Yu



Function: waving flag
End-effector: flexible tube sanwiched between two-part metal adapter
Source: William Forsythe



Function: light painting
End-effector: LED light source
Source: Sebastian Costa