

Soft Robotic Approach to Food Material Manipulation

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Workshop on Food Manipulation, IEEE Humanoids, Oct. 15, 2019

Bento (Lunch Box) in Japan



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Food Industry

<https://www.youtube.com/watch?v=LmPjKW7cPB0>



Lunch Box Production: Several millions / day
Production: near market (Tokyo, Osaka, ...)
Big sales in the morning, i.e., packing at night
Completely depend on humans but difficult to employ them

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Food Industry

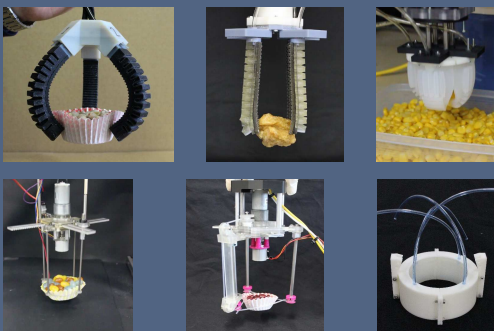
<https://www.youtube.com/watch?v=LmPjKW7cPB0>



Many soft foods
Large variation in shapes and properties
Products often change
High accuracy is not required

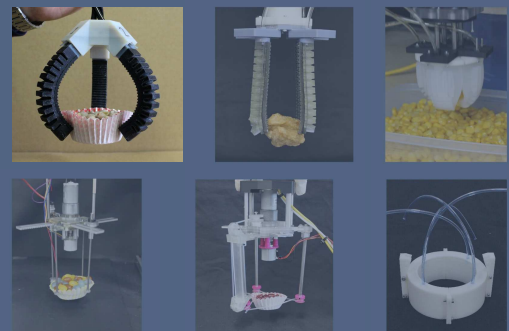
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Soft Grippers



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Printable Gripper



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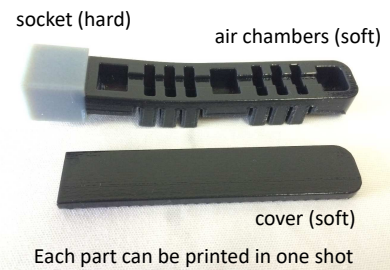
Printable Gripper



Wang et al., Robotics and Biomimetics, 2017

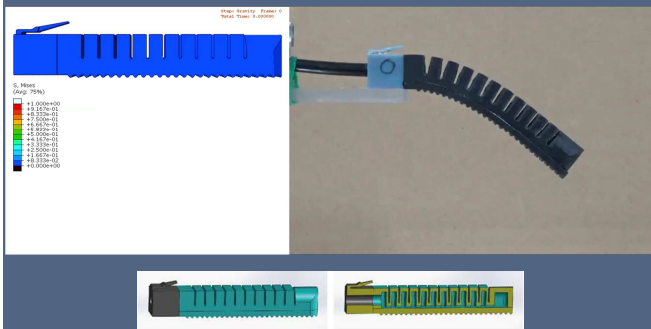
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Printable Gripper



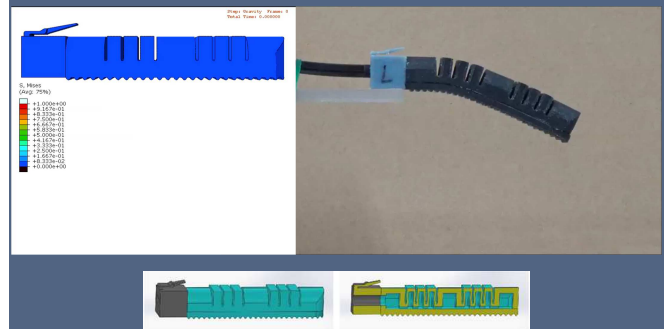
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Printable Gripper



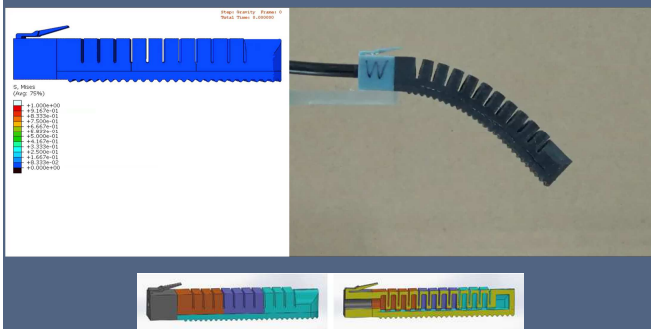
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Printable Gripper



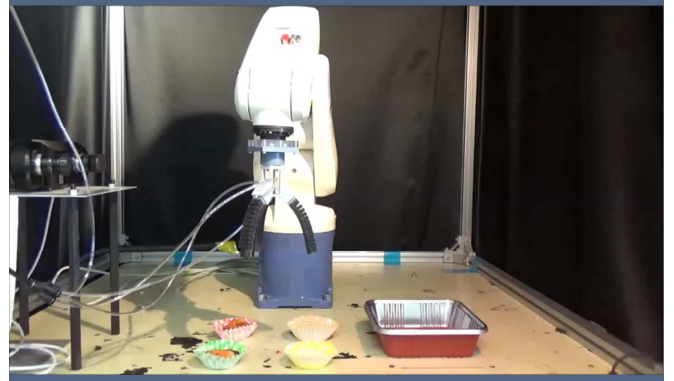
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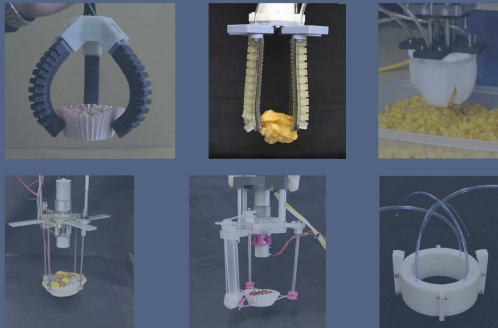


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Printable Gripper

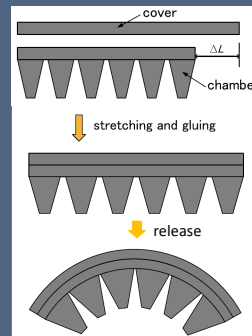


Prestretched Finger Hand



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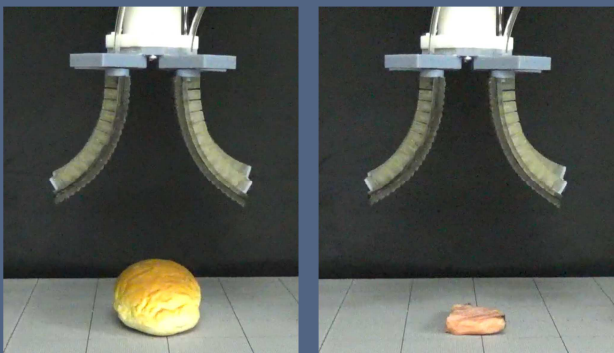
Prestretched Finger Hand



Wang et al., IEEE RAL, 2017

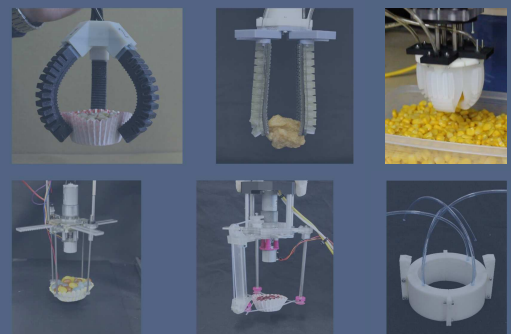
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Prestretched Finger Hand



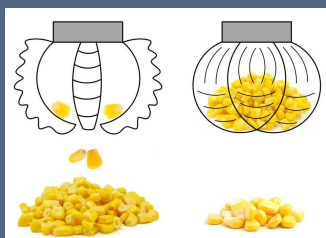
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Wrapping Gripper



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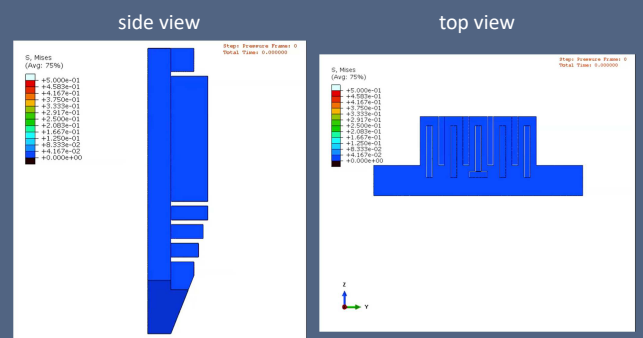
Wrapping Gripper



Kuriyama et al., IEEE RoboSoft 2019

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Wrapping Gripper



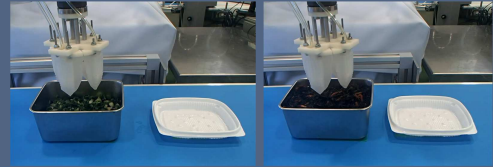
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Wrapping Gripper



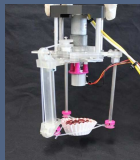
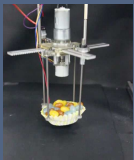
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Wrapping Gripper



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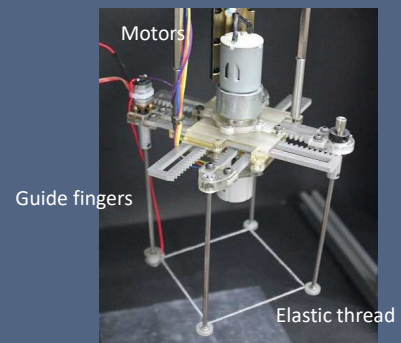
Binding Hand



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Binding Hand

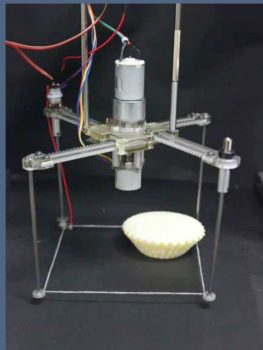
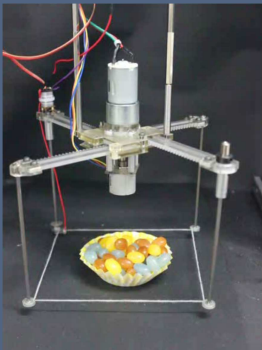
Iwamasa and Hirai, IEEE ICRA, 2015



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Binding Hand

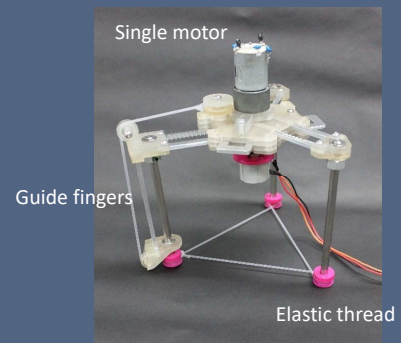
Iwamasa and Hirai, IEEE ICRA, 2015



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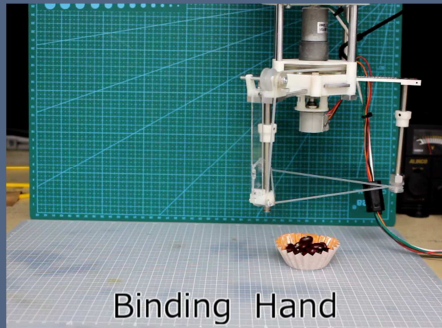
Okada et al., IEEE RoboSoft 2019



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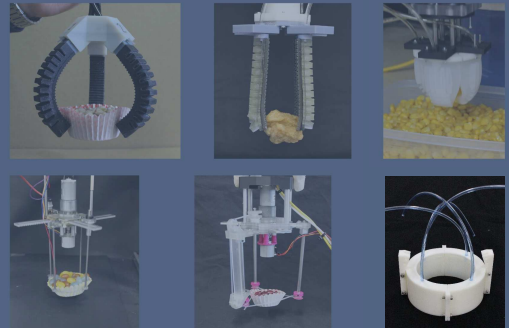
Binding Hand

Okada et al., IEEE RoboSoft 2019



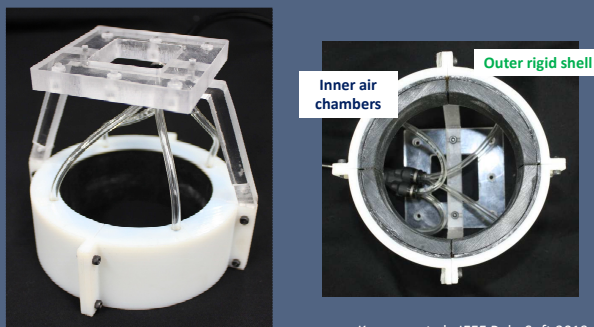
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Circular Shell Gripper



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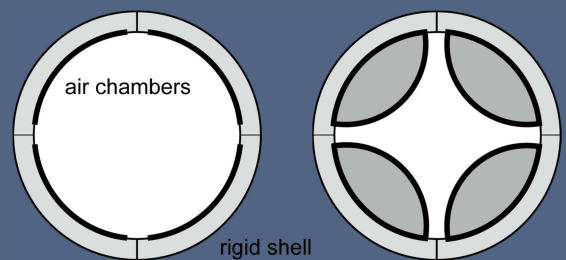
Circular Shell Gripper



Kanegae et al., IEEE RoboSoft 2019

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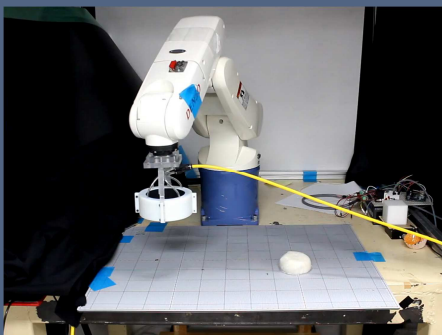
Circular Shell Gripper



Kanegae et al., IEEE RoboSoft 2019

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Circular Shell Gripper



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Circular Shell Gripper



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Toward System Integration



Developing robotic technology for food industry

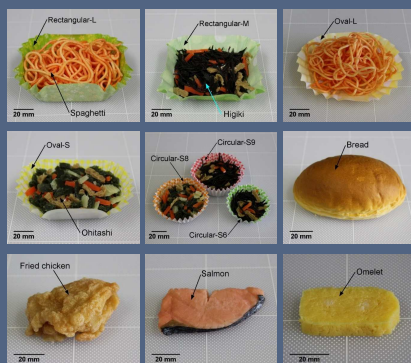
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Demonstration Room



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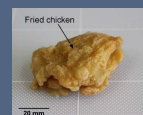
Food Database



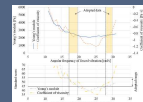
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Food Database

Shape / Textures

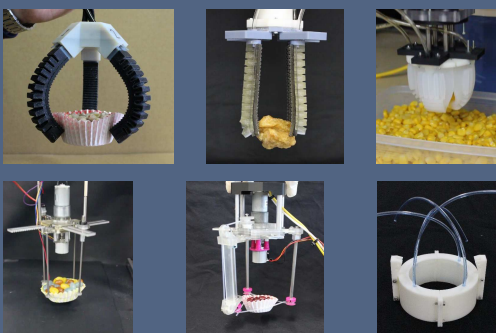


Mechanical Properties
viscoelasticity
friction / adhesion



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Summary



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Thank you for your attention

See <http://www.ritsumei.ac.jp/~hirai/>
for details

Gripper demonstration is available

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