

# Food Material Handling by Soft Robotic Hands

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International Mini-Symposium, JSFE, July 10, 2019

## Food Industry

<https://www.youtube.com/watch?v=LmPjKWtCPB0>



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

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## Food Industry

<https://www.youtube.com/watch?v=LmPjKWtCPB0>



Many soft foods  
Large variation in shapes and properties  
Often change products  
High accuracy is not required

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## Current Automation Technology



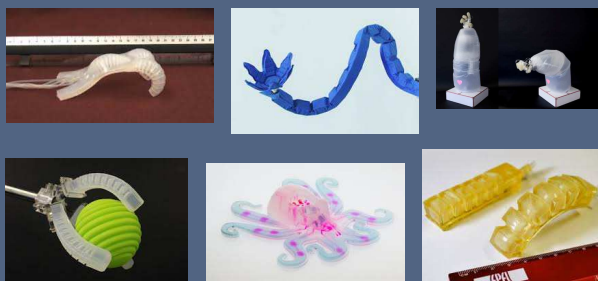
Highly accurate dimensions  
Accurate positioning  
Numerical control (NC)  
Environment control



Uncertain shapes, dimensions, and positioning  
should cope with uncertainties

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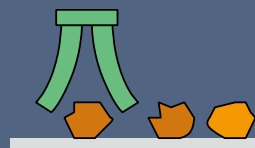
## Soft Robotics



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## Soft Robotic Automation

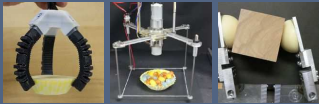
Coping with uncertainties based on soft robotics approaches



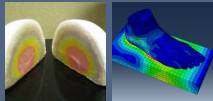
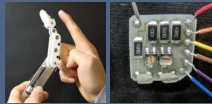
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## Soft Robotics Lab.

Robotic Hands



Actuators



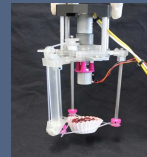
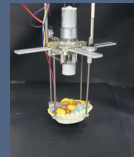
Modeling



Sensing

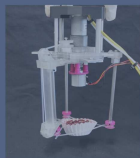
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## Soft Grippers



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## Printable Gripper



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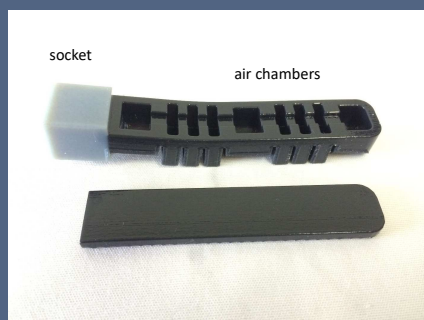
## Printable Gripper



Wang et al., Robotics and Biomimetics, 2017

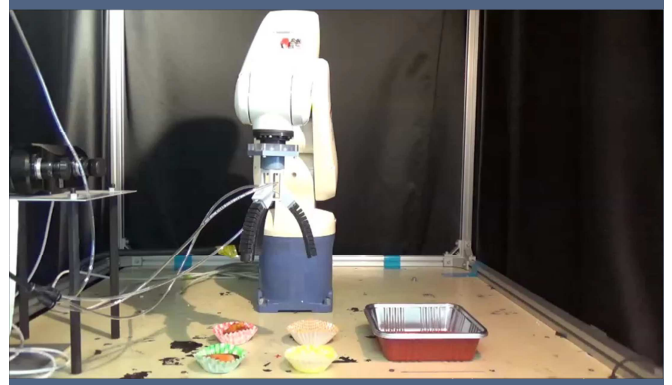
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## Printable Gripper

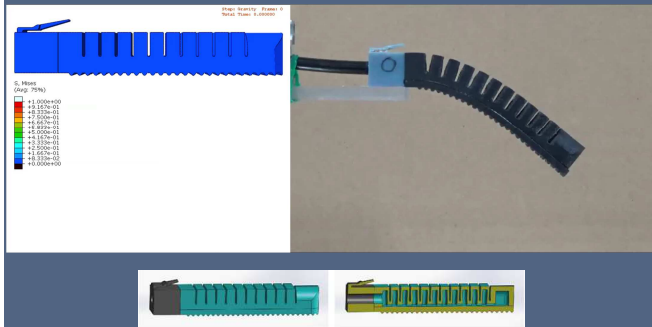


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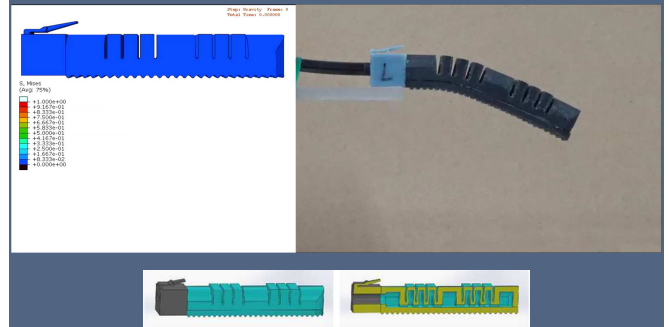


## Printable Gripper



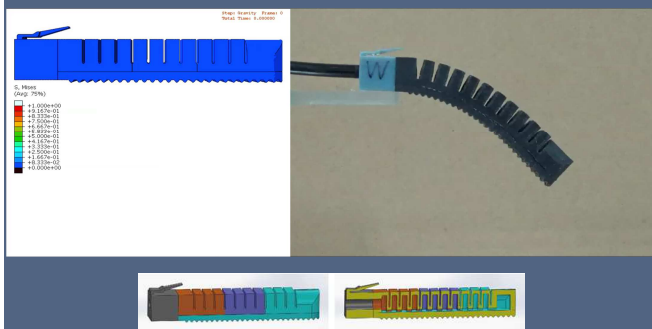
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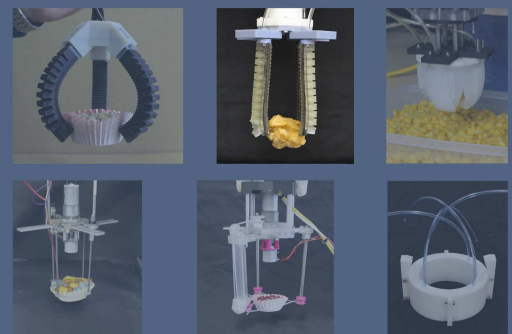
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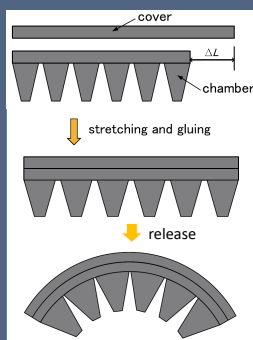
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## Prestretched Finger Hand



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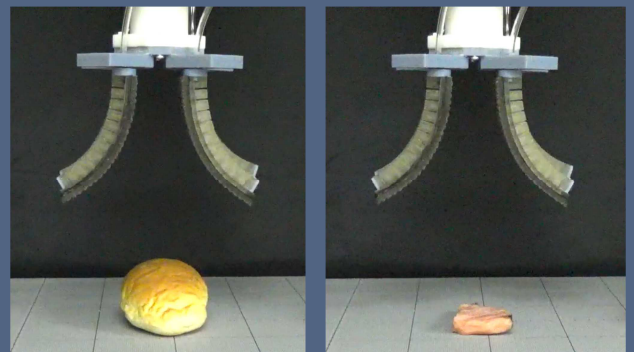
## Prestretched Finger Hand



Wang et al., IEEE RAL, 2017

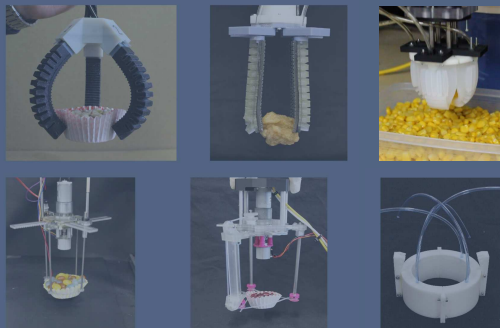
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## Prestretched Finger Hand



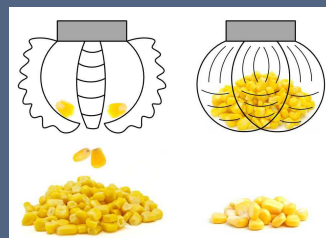
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## Wrapping Gripper



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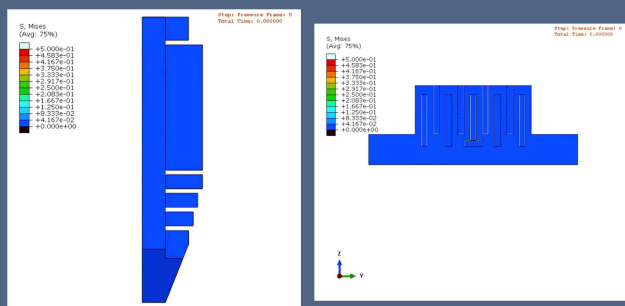
## Wrapping Gripper



Kuriyama et al., IEEE RoboSoft 2019

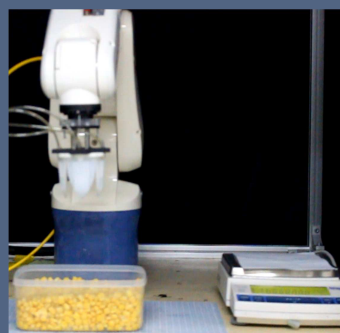
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## Wrapping Gripper



International Mini-Symposium, JSFE, July 10, 2019

## Wrapping Gripper



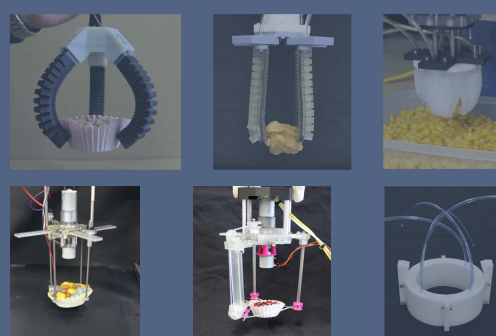
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## Wrapping Gripper



International Mini-Symposium, JSFE, July 10, 2019

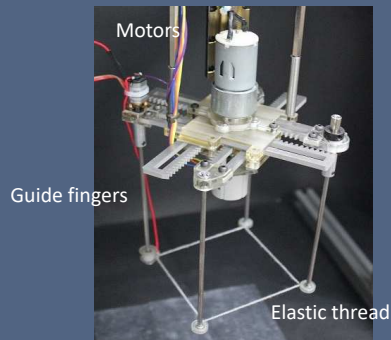
## Binding Hand



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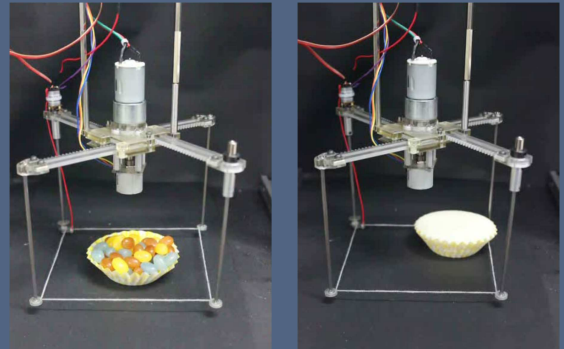
## Binding Hand



Iwamasa and Hirai, IEEE ICRA, 2015

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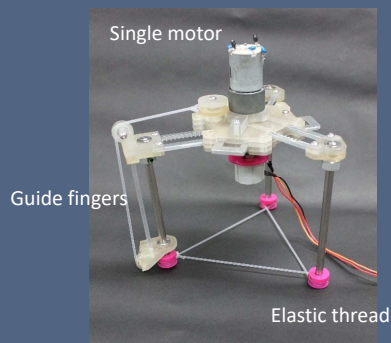
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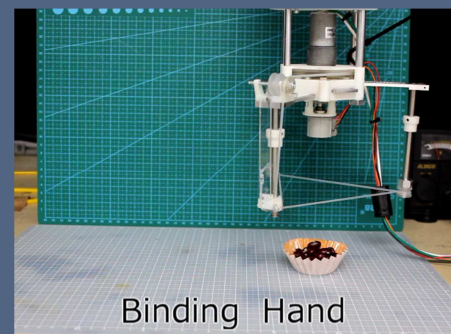
## Binding Hand



Okada et al., IEEE RoboSoft 2019

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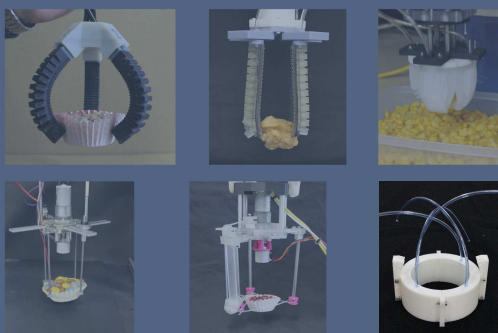
## Binding Hand



Okada et al., IEEE RoboSoft 2019

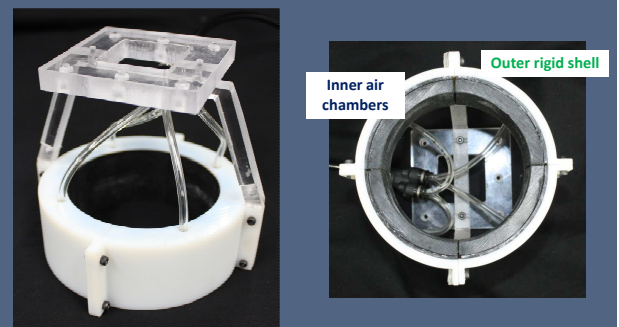
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## Circular Shell Gripper



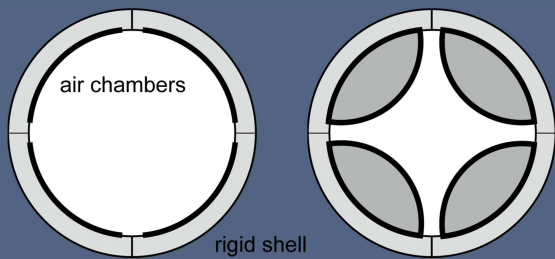
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## Circular Shell Gripper



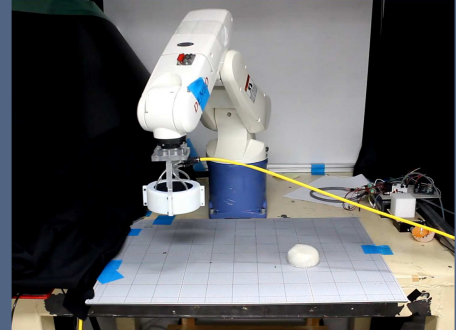
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## Circular Shell Gripper



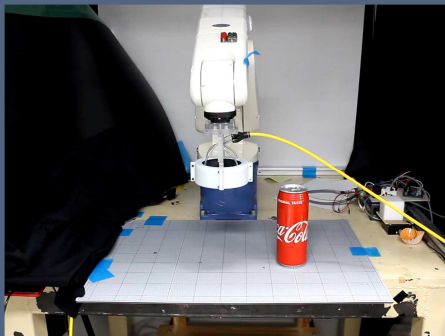
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## Circular Shell Gripper



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## Circular Shell Gripper



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## SIP Demonstration Room



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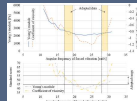
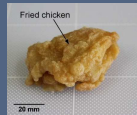


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## Toward Food Database

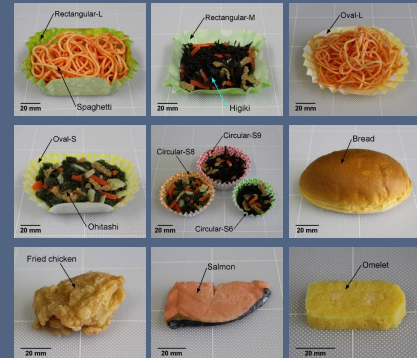
Shape / Textures

Mechanical Properties  
viscoelasticity  
friction / adhesion



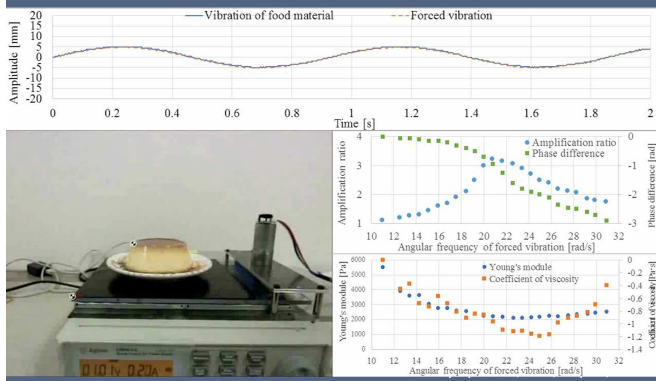
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## Food Models

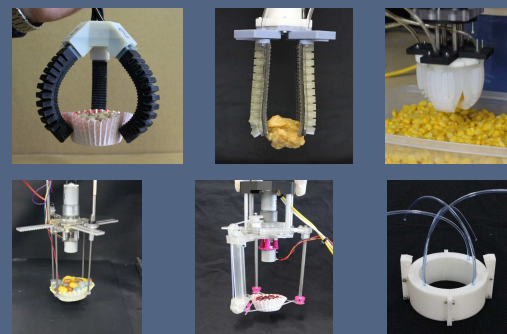


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## Viscoelasticity Measurement



## Summary



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