



syntouch

**THE  
FUTURE OF  
MACHINE  
TOUCH**



# BIOMIMETIC BY DESIGN

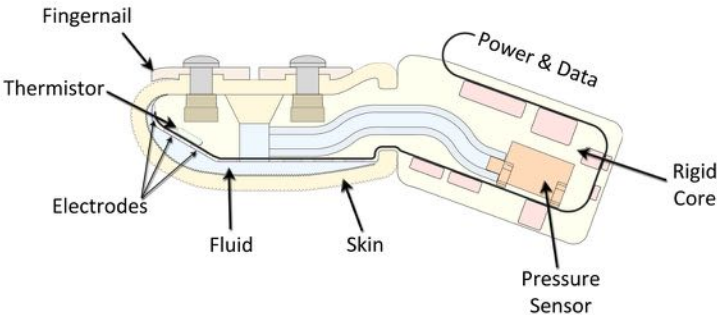
## THE BIOTAC®



As robots are increasingly expected to replicate and replace human behavior, they must increasingly behave like humans. At SynTouch, we believe that such biomimetic goals are best facilitated by biomimetic systems.

In developing the BioTac, SynTouch engineers recognized the elegant and effective design of the human fingertip and have crafted a sensor after it. The BioTac is capable of sensing the full range of forces, vibrations, and temperature that humans can perceive. Biomimetic features such as fingerprints, fingernails, and even heat generation improve the sensitivity and functionality of the device. This places the BioTac in a class of its own for human-like tactile sensing.

### SCHEMATIC

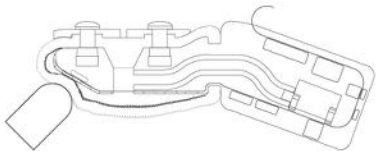


The **BioTac** consists of a rigid bone-like core covered by a replaceable elastic skin.

### SPECIFICATIONS

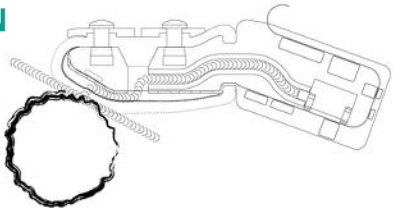
SENSOR MODALITY	RANGE	RESOLUTION	FREQ. RESPONSE
Force	0-50N	10 mN	0-100 Hz
Fluid Pressure	0-100 kPa	37 Pa	0-1040 Hz
Microvibration	±760 Pa	0.4 Pa	10-1040 Hz
Temperature	0-75 C	0.1 C	0-22.6 Hz
Thermal Flux	±1 C/s	0.001 C/s	0.45-22.6 Hz

### FORCE



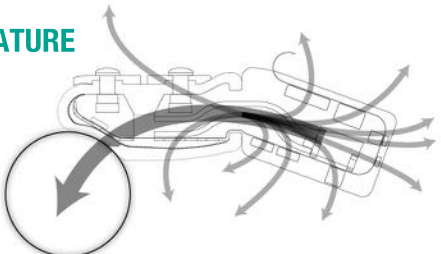
**Contact forces** distort the elastic skin and underlying conductive liquid, changing the impedances of electrodes distributed over the surface of the rigid core

### VIBRATION



**Vibrations** in the skin propagate through the fluid and are detected by the pressure sensor

### TEMPERATURE



**Temperature and heat flow** are transduced by a thermistor near the surface of the rigid core



# RESEARCH AND APPLICATIONS



## PERCEPTION

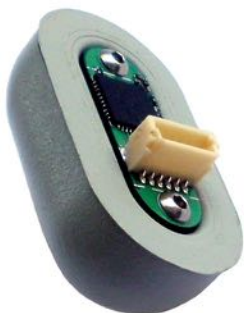
The ability to identify objects by touch is one of the core functions of human tactile sensing. Due to its biomimetic design, the BioTac is the world's only tactile sensor capable of replicating such perceptions. Processing of raw sensory data gives the BioTac the ability to discriminate and identify objects based on their compliance, texture and thermal properties, with performance as well as – and sometimes even better than – human perception with the SynTouch Standard.

## DEXTERITY

As anyone who has ever had their hands numb from the cold already knows, hands that cannot feel aren't very dexterous. Robotic hands without the sense of touch should not be expected to perform any better. Touch is what gives us the ability to perform complicated dexterous movements and reflexively manage unexpected events. Information from the BioTac can be used to detect initial contact, contact location, slip, radius of curvature, and edges, as well as determine tri-axial force to enable dexterous handling of objects with unknown properties in unknown locations. Combined with biomimetic compliance to enable delicate interaction, the BioTac is uniquely suited to improve robotic dexterity.



Photo provided courtesy of NIST



## THE NUMATAC®

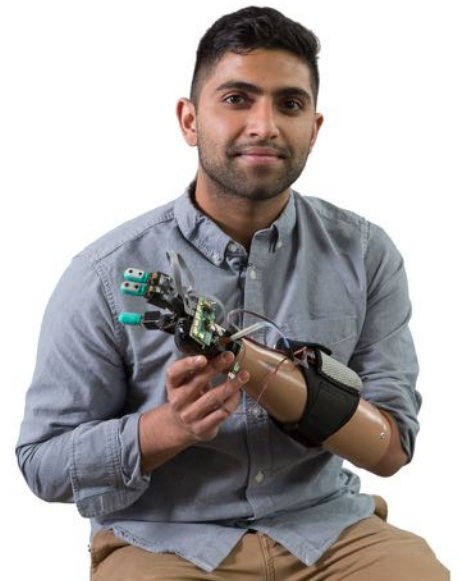
Compliance and sensitivity to contact are incredibly useful for dexterous interaction and mitigation of collision forces. To address this need, SynTouch has developed the Numatac, a simplified version of the BioTac providing high contact sensitivity in a compliant package. Due to its foam-based design it can be easily molded in a variety of shapes and sizes to cover robotic fingertips, hands and arms to provide safe and intelligent interaction.

# SYSTEMS AND INTEGRATION

## CUSTOM INTEGRATION

SynTouch specializes in providing Machine Touch™: complete tactile sensing solutions for robotic systems. Our research team is made of experts in both human and artificial tactile sensing who have been pioneering touch-based applications in robotics.

Whether your needs are in mechanical and electrical integration or software and firmware development, SynTouch is your resource to bring human-like tactile perception and reflexive dexterity to your project.



BioTac sensors equipped on a prosthetic hand to enable compliant grasping reflexes.

## ROBOTIC SYSTEMS



Shadow Hand  
Shadow Robot Company



JACO  
Kinova



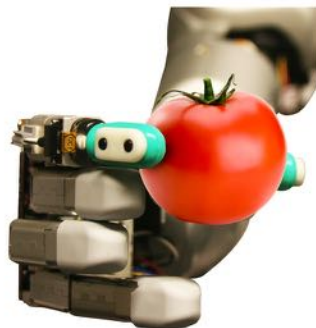
BarrettHand  
Barrett Technology



PR2  
Willow Garage



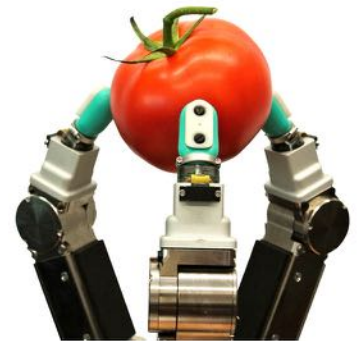
Allegro Hand  
Simlab



HUBO  
KAIST



Adaptive Gripper  
Robotiq



SDH  
Schunk