

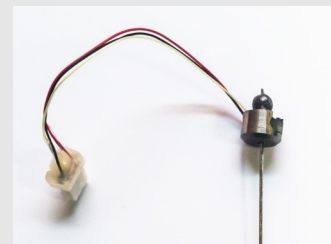
Miniature Tendon force sensor for micro-rope force measures

Small: 6mm diameter  
Highly Scalable  
Customizable

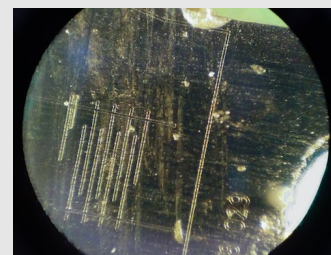
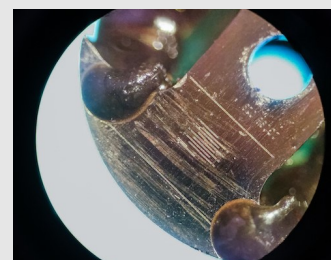
## TENDON FORCE SENSOR

These load cells are capable of measuring micro-rope or tendon forces up to 80 N. We have worked with our suppliers to find a miniaturized solution to tendon force monitoring, obtaining a 6mm diameter sensor.

Now tendon-driven robots like the i-Cub platform or the IH2 Azzurra hand can be instrumented with these sensors for augmented grasping and manipulation. Sensors are available bare or with custom acquisition electronics.



Tendon force sensor

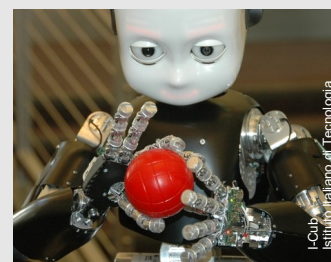


Strain gauge position

Proposed sensing scenarios

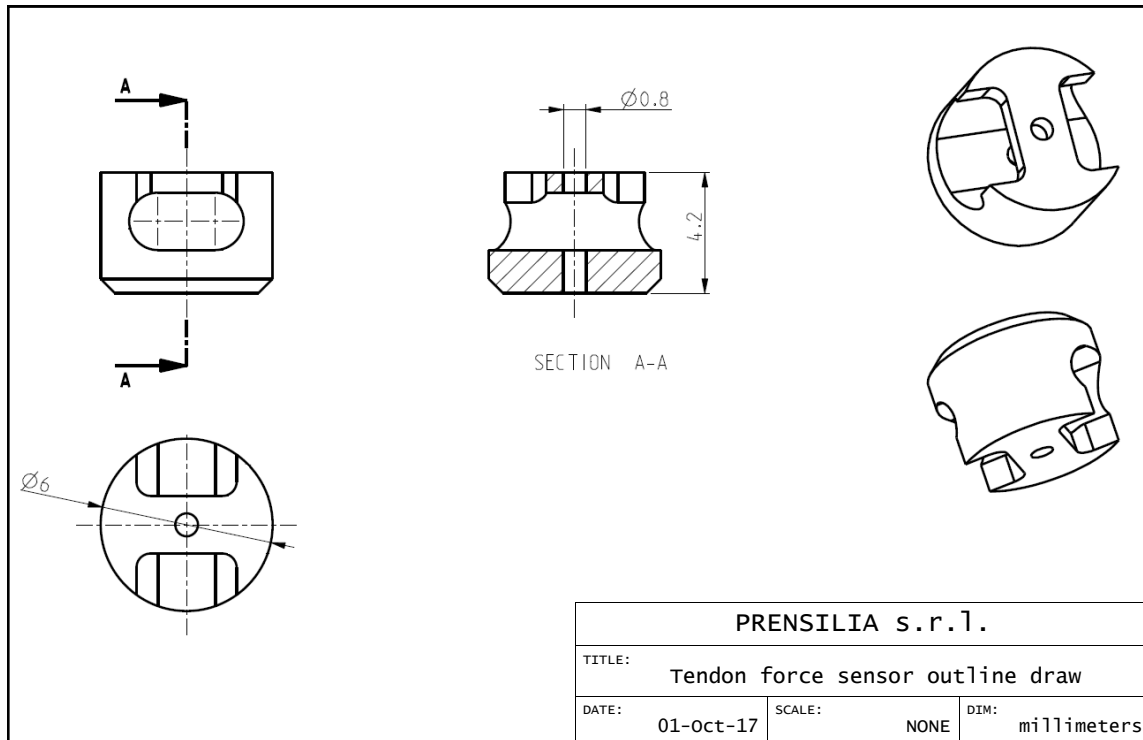


Prosthetics: IH2 Azzurra



Humanoid robotics: i-Cub

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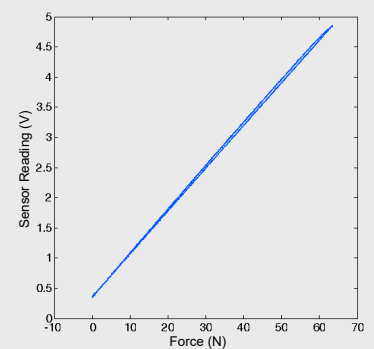
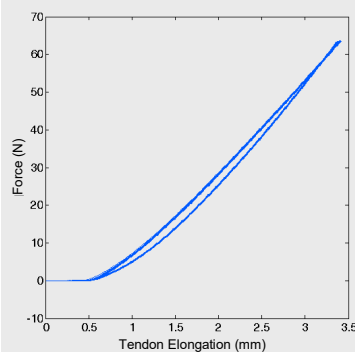


## Sensor Specifications

Mechanical Input	Tendon Force Range	80 N
	Maximum safe overload	160 N
Electrical Input	Input Voltage	$10 \pm 5 V_{DC}$
	Insulation Resistance	$1 +\infty/-0 G\Omega @ 50 V_{DC}$
	Insulation Breakdown Voltage	$100 +\infty/-0 V_{DC}$
Electrical Output	Rated Output	0.5 mV/V
	Bridge Configuration	3-Wire Half Bridge
	Bridge Resistance	$1000 \pm 10\Omega$
	Temperature Coefficient of Resistance (TCR)	$0 \pm 20 \%/^{\circ}C$
	Temperature Coefficient of Sensitivity (TCs)	$0.030 \pm 0.010 \%/^{\circ}C$
Termination (customizable)	Number of Leads	3
	Wire type/colour	UAA-3607
	Wire length	55 mm
Environmental	Encapsulation	SCC3
	Service Temperature Range	$-40/+140 ^{\circ}C$

## Acquisition using IH2 Azzurra\*

Acquisition system	Circuit Gain	3300 mV/mV
	ADC Voltage range	3.3V
	ADC Resolution	10 bits 1024 quantization levels
	ADC Voltage resolution	3.22 mV / LSB
	Sampling Rate	100 Hz
Sensor Performance	Tendon Force Range	64 N
	Sensor Vcc	5 V
	Sensitivity <sub>Vcc=5</sub>	51.6 mV/N
	ADC sensitivity	0.0625 N/LSB
	Hysteresis	1.39 %FSO
	Linearity Error	1.21 %FSO
	Repeatability	1.56 %FSO



\*The information reported in this table applies only if the tendon tension sensors are acquired using IH2 Azzurra embedded electronic boards (main control board version 2.1 - secondary board version 2.1). The tendon elongation speed was set to 0.2 mm/min.