

AVATAR INSTRUMENTS

Instrument handles, shafts and scope for Haptic Avatar

DATA SHEET



Avatar Instruments are the representations of surgical instruments that the trainee holds in a **Haptic Avatar** simulation. Each instrument is a handle on an interchangeable shaft. When the shaft is inserted into an Avatar Port, the Port reads its identification tip and the simulation shows the right instrument. Handles with a moving part are measured by the **IBox**, and the grasper and the clip applier also give **force feedback in the handle**, so the trainee feels, for example, the tissue being held. The Scope represents a laparoscope with its camera, for training camera navigation and horizioning.

FEATURES

- **Identification tip** on every shaft: the Port identifies the instrument upon insertion.
- **Quick connector**: any shaft mates with any handle and is released with a button press.
- **Handle force feedback** in the grasper and the clip applier, from a motor in the handle.
- **Handle sensing**: the opening of the thumb grip or lever, at **0.01°** resolution.
- **Push-pull connectors** and **hot-swapping**: change handles while the IBox is running.
- **Automatic calibration** of the handle sensors when connected and when not in use.
- **An LED on every handle**, e.g. to show the trainee which tool to pick next.
- **Shaft length**: standard **310 mm**, customizable **200–450 mm**.
- **Scope** with a 360° camera angle sensor for horizioning training, a zoom knob and three buttons.
- **Special instruments on request**, e.g. real instruments adapted for Haptic Avatar.

INSTRUMENTS

**Grasper****HA-IN-002 · HA-IN-003**

Represents a grasping forceps, a dissector, a scissor and similar. The trainee manipulates the thumb grip. With force feedback (HA-IN-002) a motor drives the thumb grip so the interaction with tissue is felt; HA-IN-003 is the same handle without force feedback.

MEASURES

Thumb grip

FORCE FEEDBACK

Yes (HA-IN-002)

No (HA-IN-003)

**CONNECTS TO
SIZE**

IBox

146 × 129 × 30 mm

**Clip Applier****HA-IN-006**

Represents a generic clip applier. The trainee fires the clips with the lever, and force feedback sets the lever's resistance.

MEASURES

Firing lever

FORCE FEEDBACK

Yes

**CONNECTS TO
SIZE**

IBox

106 × 141 × 30 mm

**Needle Driver****HA-IN-004**

Represents a typical needle driver. The thumb grip locks when closed and is released with a button. It has no force feedback.

MEASURES

Thumb grip

FORCE FEEDBACK

No

**CONNECTS TO
SIZE**

IBox

181 × 73 × 30 mm

**Straight Tool With Pushbuttons****HA-IN-005**

Represents any instrument with no other interaction, or one or two buttons: a diathermy hook, a suction/irrigation instrument or an arthroscopic shaver.

MEASURES

Pushbuttons

FORCE FEEDBACK

No

**CONNECTS TO
SIZE**

IBox

175 × 29 × 31 mm

**Scope****HA-SD-001**

Represents a laparoscope with camera. A 360° absolute sensor measures the scope's rotation relative to the camera head, and the fiber light connector shows the orientation of the optics, for angled scopes and horizonizing. Zoom knob and three general purpose buttons.

MEASURES

Camera angle, zoom, 3 buttons

FORCE FEEDBACK

No

**CONNECTS TO
SIZE**

USB, black shaft

164 × 58 × 42 mm

Handles weigh less than 150 g without the shaft and connect to the IBox with a 1.8 m cable and a push-pull connector. Sizes: length along the shaft × height × width, without shaft and cable, measured in the CAD models.

PERFORMANCE

	RANGE	RESOLUTION	PEAK STRENGTH
Handle grip (force feedback)	0–100 %, typically 30°	0.1 %, 0.01°	10 N
Scope camera angle	0–360°, unlimited turns	<0.1°	–
Scope zoom knob	0–360°, unlimited turns	32 ticks per turn	–

Handle values for the force feedback grasper. Peak strength is held for a limited time: the IBox predicts the motor winding temperature and limits the output to protect the handle.

SHAFTS



Instrument Shaft

HA-IN-001

The shaft is the part that is inserted into a Port. It is threaded, so the Port can grab it lengthwise, and has two grooves along its length, so the Port can grab it rotation-wise; the trainee need not mind its orientation. It mates with any handle through the quick connector. Each shaft has a colour that represents its identity, read by the Port upon insertion. Up to 20 shafts can be told apart; a standard set of 7 covers most surgical procedures. Standard 310 mm for laparoscopy and thoracoscopy, 210 mm for arthroscopy. Any length from 200 mm to 450 mm at purchase.

STANDARD SET

Red	Orange	Yellow	Green	Blue	Purple	Black
Force feedback				Sensing		Scope

EXTENDED SET

Brown	Grey	White
Additional scope	Special instrument 1	Special instrument 2

Mate a handle with a shaft and connect it to the IBox connector of the same colour. Handles with force feedback need red, orange, yellow or green. The black shaft is for the Scope.

IBOX



HA-IB-001

The IBox reads the handles and drives their force feedback. Each of its 6 channels measures one degree of freedom, typically the opening of a thumb grip or lever; the 4 force feedback channels also measure the applied force to control the motor. It controls the LEDs on the handles, calibrates their sensors and protects their motors from overheating. Handles connect with all-metal push-pull connectors and can be hot-swapped, and the IBox mounts on a quick connector, without tools. A Double Footswitch Pedal can be connected to the IBox.

PROPERTY	SPECIFICATION
Channels	6, of which 4 with force feedback
Connection	USB; USB-charged, with an internal Li-Ion battery for the motors 3.5 mm audio jack for the pedal
Size	180 × 49.4 × 57 mm (L × W × H)
Weight	800 g

For fewer channels, no force feedback or connectors in your own panel: contact Follou.

ACCESSORIES



Double Footswitch Pedal

HA-ES-001

Connects to the IBox with a 3.5 mm jack on a 1.8 m cable.



Instrument Holder Stand

HA-BA-004

Seven instrument positions, for every tool including the Scope, and a quick connector bracket for an IBox.

SPECIAL INSTRUMENT ADAPTATION

Because of the Avatar's unique system with a Port that accepts a simple threaded/grooved instrument shaft, and instruments that are individually sensed/detected, adaptation to special instruments is straightforward.

THE ORIGINAL INSTRUMENT



ADAPTED FOR HAPTIC AVATAR



EXAMPLE

The example shows an Echelon Flex 35 (ETHICON) which is equipped with sensors to interact with the Avatar System.

OTHER EXAMPLES

ETHICON Echelon Flex 3000
Covidien Signia staplers
Medtronic Endostitch

CONNECTION

Depending on the number and type of sensors needed, the instrument handle is either USB-connected, or connected to the IBox.