

SensAble Technologies

is transforming the way people use computers in the 21st century.

Our groundbreaking technology allows you to fully interact with your computer via your sense of touch.

Two dimensions – *sight and sound* – become three, *sight, sound and now touch*. And that gives you the freedom to work in a more natural, intuitive way.

HAPTICS

the magic of touch

SensAble's touch-enabled solutions simplify work so you are more productive. Imagine modelers sculpting as naturally in digital form as they do in clay— or surgeons perfecting their craft touching virtual patients instead of actual people.



PHANTOM™ Product Line

Developed at MIT, the PHANTOM device represents a revolution in human computer interface technology. Prior to its invention, computer users only had the capability to interact through the sense of sight, and more recently, sound. The sense of touch, the most important sense in many tasks, has been conspicuously absent. The PHANTOM device changes all of this. Just as the monitor enables users to see computer-generated images, and audio speakers allow them to hear synthesized sounds, the PHANTOM device makes it possible for users to touch and manipulate virtual objects.

The PHANTOM haptic interface is distinguished from other touch interfaces by what it is not. It is not a bulky exoskeletal device, a buzzing tactile stimulator nor a vibrating joystick. Each of the five models in the PHANTOM product line is a patented and elegant design that provides high-fidelity, 3D force-feedback, the ability to operate in an office/desktop environment and compatibility with standard PCs. PHANTOM application areas include medical and surgical simulation, design, engineering, geophysics and nanomanipulation.



PHANTOM Premium Line

The original PHANTOM models provide broad ranges in workspace, stiffness and motor force to accommodate the specific requirements of different projects and applications. Systems are equipped with a passive 3 degrees of freedom stylus or thimble. An optional Encoder Stylus enables measurement of an additional 3 degrees of freedom (pitch, roll, and yaw). This provides a system capable of 6 degrees of freedom input (measurement) and 3 degrees of freedom output (force feedback). All systems connect to the parallel port via a provided parallel cable.

PHANTOM Desktop

The PHANTOM Desktop easily connects to the computer via the parallel port and is powered by a compact, universal (110/230VAC) power supply. The PHANTOM Desktop comes standard with an integrated encoder stylus that provides 6 degrees of freedom positional sensing.

PHANTOM 1.5/6DOF

The PHANTOM 1.5/6DOF device allows users to explore application areas that require force feedback in six degrees of freedom (6DOF). Examples include virtual assembly, virtual prototyping, maintenance path planning, teleoperation, and molecular modeling. Simulating torque force feedback makes it possible to feel the collision and reaction forces and torques of a part in a virtual assembly path, or the rotational torques supported by a remote "slave" robot in a teleoperation environment. This system provides force feedback in three translational degrees of freedom and a range of motion that approximates lower arm movement pivoting at the user's elbow. In addition, this system provides torque feedback in three rotational degrees of freedom in the yaw, pitch and roll directions through a powered gimbal. The PHANTOM 1.5/6DOF connects to PCs running Windows NT/2000/XP and RedHat Linux 7.2 via the parallel port.



Model	Desktop	Premium 1.0	Premium 1.5	Premium 3.0
Workspace	6 x 5 x 5 inches 16 x 13 x 13 cm	5 x 7 x 10 inches 13 x 18 x 25 cm	7.5 x 10.5 x 15 inches 19.5 x 27 x 37.5 cm	16 x 23 x 33 inches 41 x 59 x 84 cm
Range of motion	Hand movement pivoting at wrist	Hand movement pivoting at wrist	Lower arm movement pivoting at elbow	Full arm movement pivoting at shoulder
Nominal position resolution	1100 dpi 0.02 mm	860 dpi 0.03 mm	860 dpi 0.03 mm	> 1000 dpi 0.02 mm
Backdrive friction	0.23 oz. 0.06 N	0.15 oz. 0.04 N	0.15 oz. 0.04 N	0.75 oz. 0.2 N
Maximum exertable force	1.45 lbf. 6.4 N	1.9 lbf. 8.5 N	1.9 lbf. 8.5 N	4.9 lbf. 22 N
Continuous exertable force (24 hrs)	0.4 lbf 1.7 N	0.3 lbf. 1.4 N	0.3 lbf. 1.4 N	0.7 lbf. 3 N
Stiffness	Approx. 18 lbs./in. 3.16 N/mm	20 lbs./in. 3.5 N/mm	20 lbs./in. 3.5 N/mm	5.7 lbs./in. 1 N/mm
Inertia (apparent mass at tip)	< 0.17 lbm. < 75 g	< 0.17 lbm. < 75 g	< 0.17 lbm. < 75 g	< 0.35 lbm. < 150 g
Footprint	7 x 6 inches 18 x 16 cm	10 x 13 inches 25 x 33 cm	10 x 13 inches 25 x 33 cm	8 x 8 inches 20 x 20 cm
Force feedback	x, y, z	x, y, z	x, y, z	x, y, z
Position sensing	x, y, z, pitch, roll, yaw	x, y, z (6DOF optional)	x, y, z (6DOF optional)	x, y, z (6DOF optional)
Interface	Via parallel port. No special cards required.	Via Parallel Port.	Via Parallel Port.	PCI interface card
Supported platforms	Intel-based PCs	Intel-based PCs	Intel-based PCs	Intel-based PCs

PHANTOM 1.5/6DOF

Degrees of freedom	Force feedback	6 degrees of freedom	
	Position sensing	6 degrees of freedom	
Workspace	Translational	7.5 x 10.5 x 15 inches	19.5 x 27 x 37.5 cm
	Rotational, yaw & roll	335 degrees	5.847 radians
	Rotational, pitch	260 degrees	4.538 radians
Nominal resolution	Translational	0.001 inch	0.03 mm
	Rotational, yaw & pitch	0.0023 degrees	0.00004 radians
	Rotational, roll	0.0080 degrees	0.00014 radians
Maximum exertable force and torque	Translational	1.9 lbf	8.5 N
	Rotational, top 2 axes	73 oz-in	515 mNm
	Rotational, handle axis	24 oz-in	170 mNm
Continuous exertable force and torque	Translational	0.3 lbf	1.4 N
	Rotational, top 2 axes	27 oz-in	188 mNm
	Rotational, handle axis	7 oz-in	48 mNm

GHOST® SDK

While the PHANTOM device provides actual forces to the user, GHOST software handles the many complex computations required to realistically simulate physical interaction with digital objects. This easy-to-use toolkit allows developers to incorporate the “physics engine” into their 3D applications quickly and easily, while the API’s robust and extensible architecture provides the power and flexibility researchers require. The GHOST SDK is available for Windows NT/2000/XP and also RedHat Linux 7.2 platforms and has a broad feature list.

- Support for current and future PHANTOM devices
- Integrated mouse driver
- “Force field” class to enable the mixing of scene graph and direct force programming
- Support for polymeshes with up to 250,000 editable polygons
- Support for VRML 2.0 for ability to render static objects directly into the haptic scene graph
- DLL based implementation simplifies development, support and upgrading of 3D Touch™ applications
- Support for multiple PHANTOM Desktops in a daisy-chained configuration using only a single port on the host machine

Medical/Dental
Teleoperation
Nanomanipulation
3D Design/Engineering
Geophysical
Other 3D Applications

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System Requirements:

Intel-based PCs
Windows NT SP6, Windows 2000 SP3 or higher, Windows XP SP1 or higher,
or RedHat Linux 7.2

300 MHz Pentium processor, 64 MB RAM, 30 MB free disk space, hardware graphics accelerator