



BDSYSTEMS®



Haptic Devices and Toolkits

Geomagic® Touch™

Geomagic® Touch™ X

Geomagic® Phantom® Premium™

Geomagic® Touch™
Geomagic® Touch™ X
Geomagic® Phantom® Premium™

Haptic Devices and Software Toolkits that
Add the Sense of Touch to the Digital World



Geomagic® haptic devices provide true three-dimensional navigation and force feedback, integrating the sense of touch into research and commercial applications as well as into the Geomagic® Freeform® and Geomagic® Claytools® 3D modeling systems. Each Geomagic haptic device can accurately measure the 3D spatial position (along the x-, y- and z-axis) and the orientation (roll, pitch and yaw) of its handheld stylus. The devices use motors to create forces that push back on the user's hand to simulate touch and interaction with virtual objects. Depending on the model, Phantom devices provide either 3- or 6-Degree-of-Freedom (DOF) force feedback.

Academic, Research and OEM Applications

Geomagic haptic devices are used in a broad range of applications, as well as cutting-edge R&D projects, in which intuitive, realistic interaction with the digital world is desired. On several models, the device's end effector can be customized to simulate a variety of tools. OEM applications include medical simulations and training exercises in which the stylus emulates the physical sensations – like puncturing, cutting, probing or drilling – of using a syringe, scalpel, arthroscope or other instrument.

Other commercial, scientific and research applications include:

- Robotic Control
- Virtual Assembly
- Collision Detection
- Teleoperation
- Training and Skills Assessment
- Molecular Modeling
- Rehabilitation
- Nano Manipulation
- 3D Modeling
- Applications for the Visually Impaired
- Entertainment and Virtual Reality

Device Portfolio

Geomagic haptic devices vary according to workspace size, exertable force, degrees of freedom, inertia and fidelity. Geomagic® Touch™ and Geomagic® Touch™ X devices support a range of motion equivalent to hand movement pivoting at the wrist, and power a variety of commercial, academic and research applications. The larger Geomagic® Phantom® Premium™ models provide a range of motion equivalent to arm movement pivoting at the wrist, the elbow or the shoulder. The Phantom Premium line includes High Force (HF) models and 6DOF (Degrees of Freedom) devices; 6DOF devices provide force feedback on orientation (roll, pitch and yaw) in addition to spatial position.

OpenHaptics

In all applications, Geomagic haptic devices require the use of the OpenHaptics® toolkit, which gives developers the ability to fully integrate a device's capabilities with 3D applications. At a high level, the toolkit enables Geomagic haptic device support, true 3D





navigation, material properties, and polygonal object support for applications already using OpenGL. At lower levels, the toolkit gives developers complete access to sensor readings, device control, direct control of force rendering and more. The included QuickHaptics™ micro API enables rapid program design and development, and it is ideal for mash-ups into existing applications, trying out new ideas and creating haptic examples.




The OpenHaptics toolkit is available at no charge for academic use. For commercial, OEM or non-academic developers, a developer license or a commercial OEM contract is required and fees apply. The Geomagic online Developer Support Center is available to academic customers at no charge, and it is available to OEMs and commercial developers with active OpenHaptics software maintenance contracts.

Geomagic Haptic Device Specifications

Geomagic Touch and Geomagic Touch X

	Geomagic Touch	Geomagic Touch X
		
Workspace	~6.4 W x 4.8 H x 2.8 D in > 160 W x 120 H x 70 D mm	~6.4 W x 4.8 H x 4.8 D in > 160 W x 120 H x 120 D mm
Range of motion	Hand movement pivoting at wrist	Hand movement pivoting at wrist
Nominal position resolution	> 450 dpi ~0.055 mm	> 1100 dpi ~0.023 mm
Maximum exertable force at nominal (orthogonal arms) position	0.75 lbf/3.3 N	1.8 lbf/7.9 N
Stiffness	x-axis > 7.3 lb/in (1.26 N/mm) y-axis > 13.4 lb/in (2.31 N/mm) z-axis > 5.9 lb/in (1.02 N/mm)	x-axis > 10.8 lb/in (1.86 N/mm) y-axis > 13.6 lb/in (2.35 N/mm) z-axis > 8.6 lb/in (1.48 N/mm)
Force feedback (3 Degrees of Freedom)	x, y, z	x, y, z
Position sensing/input (6 Degrees of Freedom)	x, y, z (digital encoders)	x, y, z (digital encoders)
[Stylus gimbal]	[Roll, pitch, yaw (± 5% linearity potentiometers)]	[Roll, pitch, yaw (± 3% linearity potentiometers)]
Interface	IEEE 1394 FireWire® port: 6-pin to 6-pin	IEEE 802.3 Ethernet port (USB option)

Phantom Premiums

	Premium 1.0	Premium 1.5	1.5 High Force (HF)	Premium 3.0
				
Workspace	10 W x 7 H x 5 D in 254 W x 178 H x 127 D mm	15 W x 10.5 H x 7.5 D in 381 W x 267 H x 191 D mm		33 W x 23 H x 16 D in 838 W x 584 H x 406 D mm
Range of motion	Hand movement pivoting at wrist	Lower arm movement pivoting at elbow		Full arm movement pivoting at shoulder
Nominal position resolution	860 dpi 0.03 mm	860 dpi 0.03 mm	3784 dpi 0.007 mm	> 1000 dpi ~0.02 mm
Maximum exertable force (nominal position)	1.9 lbf/8.5 N	1.9 lbf/8.5 N	8.4 lbf/37.5 N	4.9 lbf/22 N
Stiffness	20 lbf in ⁻¹ 3.5 N mm ⁻¹	20 lbf in ⁻¹ 3.5 N mm ⁻¹		5.7 lbf in ⁻¹ 1 N mm ⁻¹
Force feedback (3 Degrees of Freedom)	x, y, z	x, y, z		x, y, z
Position sensing/input (3 Degrees of Freedom with 3 additional degrees optional)	x, y, z (roll, pitch, yaw optional)	x, y, z (roll, pitch, yaw optional)	x, y, z (roll, pitch, yaw optional)	x, y, z (roll, pitch, yaw optional)
Interface	Parallel port	Parallel port	Parallel port	Parallel port
Optional end effectors	Encoder gimbal	Encoder gimbal	HF Encoder gimbal	Encoder gimbal

Geomagic Phantom Premium 6DOFs

	Premium 1.5/6DOF	Premium 1.5 High Force/6DOF	Premium 3.0/6DOF
			
Workspace: Translational	15 W x 10.5 H x 7.5 D in 381 W x 267 H x 191 D mm	15 W x 10.5 H x 7.5 D in 381 W x 267 H x 191 D mm	33 W x 23 H x 16 D in 838 W x 584 H x 406 D mm
Rotational Yaw Pitch Roll	297 degrees/5.18 radians 260 degrees/4.54 radians 335 degrees/5.85 radians	297 degrees/5.18 radians 260 degrees/4.54 radians 335 degrees/5.85 radians	297 degrees/5.18 radians 260 degrees/4.54 radians 335 degrees/5.85 radians
Range of motion	Lower arm movement pivoting at elbow	Lower arm movement pivoting at elbow	Full arm movement pivoting at shoulder
Nominal position resolution: Translational	860 dpi/0.03mm	3784 dpi/0.007 mm	> 1000 dpi / ~0.02 mm
Rotational Yaw and Pitch Roll	0.0023 degrees/0.00004 radians 0.0080 degrees/0.00014 radians	0.0023 degrees/0.00004 radians 0.0080 degrees/0.00014 radians	0.0023 degrees/0.00004 radians 0.0080 degrees/0.00014 radians
Maximum exertable force and torque at nominal position (orthogonal arms): Translational	1.9 lbf/8.5 N	8.4 lbf/37.5 N	4.9 lbf/22N
Rotational Yaw and Pitch Roll	73 oz-in/515 mNm 24 oz-in/170 mNm	73 oz-in/515 mNm 24 oz-in/170 mNm	73 oz-in/515 mNm 24 oz-in/170 mNm
Stiffness	20 lbf in ⁻¹ 3.5 N mm ⁻¹	20 lbf in ⁻¹ 3.5 N mm ⁻¹	5.7 lbf in ⁻¹ 1 N mm ⁻¹
Force feedback (6 Degrees of Freedom)	x, y, z, Tx, Ty, Tz	x, y, z, Tx, Ty, Tz	x, y, z, Tx, Ty, Tz
Position sensing/input (6 Degrees of Freedom)	x, y, z, roll, pitch, yaw	x, y, z, roll, pitch, yaw	x, y, z, roll, pitch, yaw
Interface	Parallel port	Parallel port	Parallel port
Optional end effectors	Thumb pad (pinch), scissors	Thumb pad (pinch), scissors	Thumb pad (pinch), scissors

Specifications subject to change. Complete specifications at www.geomagic.com.

ABOUT US

3D Systems is a leading global provider of 3D content-to-print solutions including 3D printers, print materials and on-demand custom parts services for professionals and consumers alike. The company also provides CAD modeling, reverse engineering and inspection software tools and consumer 3D printers, apps and services. Its expertly integrated solutions replace and complement traditional methods and reduce the time and cost of designing and manufacturing new products. 3D Systems products and services are used to rapidly design, communicate, prototype or produce real functional parts, empowering customers to create and make with confidence.

WORLD-CLASS SUPPORT

Technical support and maintenance contracts are available for Geomagic haptic devices and OpenHaptics software. Access to the online Developer Support Center (DSC) is provided free to academic customers. Full details on the support offerings are available at www.geomagic.com.

*Image credits: 3D virtual assembly simulation developed by the Iowa State University Virtual Reality Applications Center, in conjunction with John Deere. Photo courtesy of Iowa State University Virtual Reality Applications Center. ScanTrainer, from UK-based MedaPhor Ltd, is a virtual-reality ultrasound training simulator which bridges the gap between textbook and patient. Photo courtesy of MedaPhor Ltd. Temporal bone drilling simulator photo courtesy of Ohio State University Nationwide Children's Hospital and the Interface Lab at Ohio State University. Original publication: Wiet GJ, Stredney D, Wan D. "Training and Simulation in Otolaryngology." *Otolaryngology Clinics of North America*. Vol. 44, no. 6. (Dec 2011): 1333-1350. (1.65).*

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