Razer 3G Infrared Sensor

January 15th, 2007

Introduction

The Razer DeathAdder™ mouse introduces 3G Infrared Sensor technology powered by Razer Precision™ and pioneered by the scientists and engineers at Razer.

Optical sensors were introduced in the late 1990's and offered enhanced precision and tracking over the previous standard for navigating computer operating systems: the ball mouse. Optical sensors make use of a light-emitting diode (LED) that reflects light off the surface to a complimentary metal-oxide semiconductor (CMOS) sensor. This miniature CMOS sensor takes thousands of pictures per second of the surface pattern. A processor then interprets mouse movement and speed by comparing successive pictures. This change is, in turn, reflected on the PC display as cursor movement.

In 2004, laser sensor technology made its consumer debut. By replacing the LED with a laser, these sensors offered improvements in the sensitivity of surface tracking. Since the introduction of the laser sensor, there has been substantial marketing in the industry to promote the laser sensor as the new standard-bearer.

Although laser sensors are indeed a substantial technological advance, they do not offer across-the-board improvements to all the variables that ultimately impact a gaming mouse's performance. With the introduction of 3G Infrared Sensor technology, optical sensors offer a compelling alternative for many gamers, especially those who play at low sensitivity settings and move the mouse at high speed.

Dots-Per-Inch

The most common metric of sensor performance is Dots-Per-Inch (DPI). DPI represents the number of pixels the PC display's cursor will move when the mouse is moved one inch across the surface. When fast movement is required in a computer game, especially an action First-Person-Shooter (FPS) game like Quake™ or Unreal Tournament™, DPI is an important metric. A higher DPI allows the player to make a 180 degree turn in a three-dimensional environment with less physical movement of the mouse.

DPI has been incorrectly perceived as the defining metric of mouse performance, which has led to both a simplistic view of mouse performance and an attempt by some manufacturers to take advantage of the popular perception by artificially inflating the DPI specifications of their mice.

Razer has always believed that sensor performance features such as speed and resolution should be built directly into the mouse's firmware. Taken as the only metric, the best-in-class sensor available at the time of the publication of this white paper is rated at 2000 DPI, and is found in only two gaming mice in the market today, one of them being the Razer Copperhead™. Unfortunately, in the past year certain manufacturers have applied artificial software interpolation and lens magnification techniques in order to quote DPI figures as high as 3200. While such interpolation and lens techniques artificially inflate the DPI of the mouse, it correspondingly adversely affects the performance of the sensor in other areas such as hand movement speed which renders the mouse virtually unusable by demanding gamers.

While DPI is important, sacrificing accuracy to simply quote a large number on the retail box has hurt the ability of the consumer to make informed buying decisions.

The extent to which real, non-interpolated, native DPI is useful to a gamer depends on their play style. While the useful maximum varies between players, 3G Infrared Sensor technology has achieved advances that improve the sensor's performance to 1800 DPI, a 200 DPI increase over the previous generation of optical sensors.

Hand Movement Speed
Inches-Per-Second (IPS) represents the maximum speed at which the mouse can move over the surface and still retain accurate tracking without resulting in random cursor movements. Unlike DPI, IPS is a far more variable metric, which may explain why it has not been marketed and explained to the gaming consumer as effectively as DPI.

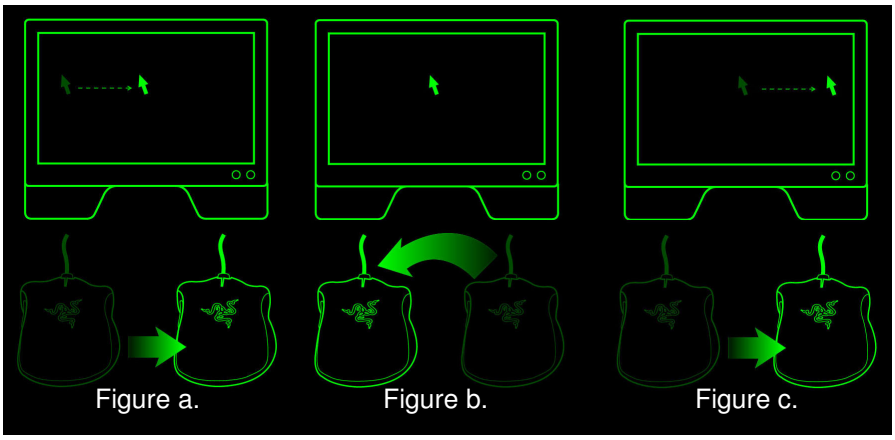
The IPS performance of a sensor is variable depending on the uniformity of the surface being tracked. As a general rule, laser sensors achieve superior IPS on smooth surfaces while optical

sensors achieve superior IPS on less uniform surfaces. The IPS rating quoted by sensor manufacturers is typically a conservative estimate that covers most common dedicated mouse surfaces. The 3G Infrared Sensor technology offers improved tracking with 60 IPS on the majority of surfaces, and even higher in optimal conditions. This represents current best-in-class performance among all sensor types.

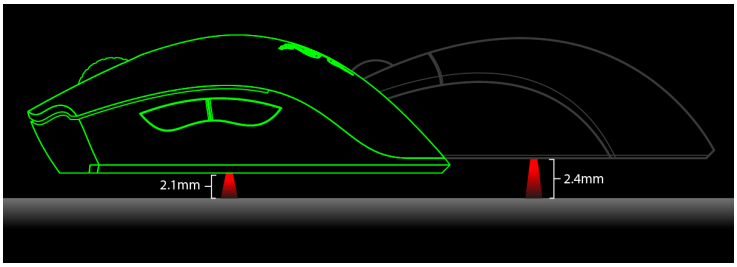
Razer has studied the hand movements of tactical FPS players of popular games like CounterStrike™ and Call of Duty™. Compared to their counterparts who play action FPS games, there is a trend in this genre to use low sensitivity settings and move the mouse at very high speeds. This allows these players to still make rapid turns, but retain the ability to move their mouse at slower speeds for pixel-precise aim when confronting an enemy in game. Razer has frequently observed players of this genre moving 19.7 inches for a 180 degree turn in a three-dimensional environment.

Players who move at high speeds, but prefer to maintain contact between the mouse feet and the surface at all times use large mouse pads to provide enough gaming surface. Currently, the mouse pads commercially available to accommodate this movement are predominantly made of cloth materials. As these pads tend to be less uniform than hard surfaces, IPS performance of the 3G Infrared Sensor technology will exceed that of laser alternatives for these players.

Lift-Off Distance
Some players use an alternative method to move their mouse at high speeds over long distances. Rather than using an oversized surface, these players move the mouse rapidly across a smaller distance (a), then physically lift the mouse back to its original position on the pad (b) and repeat the movement (c). All sensors continue tracking for a short distance after being lifted from the surface. This results in small erratic movements of the curser at the moment of lift-off.



The 3G Infrared Sensor technology offers improved lift-off performance by minimizing this distance. Like IPS, it isn't possible to quantify this distance with a single metric. However, rather than being a variable of surface texture, lift-off distance varies with surface color. Lift off distance is shorter on white surfaces than black ones. The 3G Infrared Sensor can achieve lift-off distances as low as 2.1 mm before the sensor ceases tracking on many surface colors, an improvement of the 2.4 mm minimum of the previous generation optical sensors.



Conclusion

The 3G Infrared Sensor technology sets new performance standards for optical mice. The inherent advantages of optical sensors on non-uniform surfaces, taken together with improvements in minimum lift-off distance make this a sensor of choice for high-speed gamers. Advances in the precision of optical sensors with 3G to 1800 non-interpolated, native DPI brings it into the useful maximum range of a larger proportion of gamers than the previous generation. There are advantages to both laser and optical sensors. Innovation in both technologies has provided gamers with alternatives to best suit their play styles.

Feature Comparison of Optical Sensor Generations

	1G Optical (1999)	2G Optical (2004)	3G Infrared (2007)
DPI	800	1600	1800
IPS	12	40	60
Minimum Lift-Off	3mm	2.4mm	2.1mm
Acceleration (G)	0.15	15	19
Image Size (pixels)	16x16	30x30	30x30