

## FEATURES

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## Sports games come of age

Ever wondered how video game characters are able to replicate the unique technique of a David Beckham free kick or a Tiger Woods drive?

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Top: Tiger Woods demonstrates a trick shot at Chelsea Piers golf club in New York for the launch of his EA Sports video game *Tiger Woods PGA Tour 08*. Above: Pete Sampras puts the *Grand Slam Tennis* video game through its paces. PHOTOS: BLOOMBERG

Joshua Bryant, 11, of Wallingford, Connecticut, plays the Nintendo Wii *Punch Out* game at the Nintendo World store in New York. PHOTOS: BLOOMBERG



Rory McIlroy is looking uncomfortable. Earlier this month, the hugely promising young golfer from Northern Ireland set the world alight by playing a course-record 62 in the last round of the Quail Hollow Championship in Charlotte, North Carolina. Today he is standing in the clubhouse at Wales' Celtic Manor, wearing a skintight bodysuit covered in small balls. Mercifully, this isn't a cutting-edge new direction for golf fashion; McIlroy is taking part in a motion capture session for the forthcoming *Tiger Woods PGA Tour 11* video game. Having grown up playing these ultra-realistic simulations, he will now appear on the cover alongside his lifelong hero. And when this game is released, on 2 July, gamers will get to enjoy a perfect digital copy of what some reckon is the best swing in the sport today.

Superstar motion capture, or mocap, sessions like this are not unusual in modern sports games. The graphics processors in the latest consoles are capable of rendering environments of almost photorealistic quality, but it's the integration of real human movement into computer animation that has really driven the genre. Every major sports title will now capture data from leading players, both as a way to add authenticity and as part of the marketing campaign. Wayne Rooney, Ronaldinho and Lionel Messi have all had their signature moves digitized into games — not only is it a handy source of extra income, but as most soccer players are fans of games such as *FIFA* and *Pro Evolution Soccer* it's also a badge of honor among peers.

Of course, mocap technology is not new. Optical motion capture systems were first developed in the 1970s, primarily for use in clinical gait analysis, and they have been a part of video game development for more than 15 years. During that time the principles have remained remarkably consistent. An actor or athlete dons a skintight suit covered in reflective markers and performs a sequence of actions. The movement of the markers is recorded by a series of specialist video cameras placed around the performer and the data is spat out as a set of 3D co-ordinates. This data is then checked and cleaned up before being fed into the game to generate the animation of the character model.

Beyond these essential components, however, the detail and accuracy of the mocap process has evolved hugely.

"In 1995 we'd use seven cameras, each with an effective resolution of 150k pixels, or 0.15 of a megapixel," explains Nick Bolton, CEO of Vicon, a UK company that makes motion capture equipment for the games and movie industries. "Those cameras were running at somewhere between 30 and 60 frames per second, and we could capture about 25 markers at a time. Today, we use 200 16-megapixel cameras in our LA studio and we're up to 2,000 frames per second. We can also capture 3,000 markers at once."

The process is also much more portable. In the 1990s, mocap was confined to specialist studios, but now Audiomotion can grab an array of cameras and a few computers to film in any interior location. Matt Rank, systems manager at Audiomotion,

which is handling today's shoot for EA Sports, explains: "We've been to Manchester for Rooney, equestrian centers to capture horses, ice rinks for skaters ... We took over 60 cameras to Barcelona for Messi. It takes a lot of planning and co-ordination but we can do anything-ish!"

The result of these technological improvements is an exponential rise in scale and ambition. Ten years ago, game developers could only hope to record basic movements, but nowadays they can capture the most intricate nuances. This might mean the way that David Beckham leans back when delivering a set-piece ball, or the way Tiger Woods shields his eyes to watch his ball take flight over the eighth hole at the Augusta National Golf Club.

In today's session with 21-year-old Rory McIlroy, Brian Mitchell, director of Audiomotion, is arranging takes of the golfer simply approaching the ball, then reacting to several scenarios: a disastrous slice, a moderately successful shot and, amusingly, a hole in one, with McIlroy raising his fists to the sky in glory. Mitchell even asks for separate takes with different clubs, because McIlroy's action differs slightly between a wood and an iron. Of course, none of this has an effect on the gameplay, but it means enhancing the fiction.

With more cameras and markers available, the complexity of each take can also grow. Ten years ago, the game makers would have concerned themselves with a single athlete performing a few basic moves. Now, mocap teams will capture several players interacting with each other, tussling, tackling and jockeying for the ball. For each *FIFA* soccer game, EA Sports' mocap producers run a film-style schedule, capturing 150 moves a day over a five-day period. The studio now has a database of 12,000 animations to which it will add about 1,500 new clips a year.

Motion capture staff also have to be flexible to meet the unique demands of each sport. "The playing surface has always posed a bit of a challenge," says Craig Koehn, a mocap specialist at EA Sports' vast studio in Burnaby, British Columbia, Canada. "The studio floor is concrete with rubber mats — that works fine for games like basketball but it's not great for performing sliding tackles. The original artificial turf was horrible stuff to work on so we tried installing live turf for shoots, which was fantastic but expensive. Today, we use the latest type of synthetic turf with a sand and rubber pellet base. We had custom-made square pallets of the stuff made that can be interlocked together to any configuration we want."

Importantly, though, modern video games do not rely solely on motion capture data to produce ever-more realistic human movement. The problem is, while the resulting animations look authentic, as pre-built loops they can't react in real time to unique events. In recent years, however, developers have begun merging mocap data with increasingly complex "procedural animation," which uses physics calculations and biomechanical detail to generate authentic movement on the fly. In a soccer sim, for example, this might mean a player being tackled, then tripping over and colliding awkwardly with a nearby teammate — a string of events that would be impossible to anticipate in a motion capture session. The trick is in segueing seamlessly from mocap loops into physics-based animations — it's something that developers such as EA Sports are continually refining.

Some turn to third-party solutions. A leading example is Oxford-based software company NaturalMotion, whose physics-based animation engine, Euphoria, is used by dozens of game developers seeking to build characters with more realistic in-game

reactions. According to NaturalMotion CEO Torsten Reil, the technology was originally developed within Oxford University's School of Zoology to study animal movement. "We simulated simple stick figures on the computer and hooked their muscles up to randomly generated neural networks. The best of these, in terms of performing a task such as walking, were selected by an algorithm and allowed to reproduce, with variation. These were evaluated again, and

sure you get every bit of kinetic energy transmitted through to the ball, and rehab or injury prevention. Also, baseball's National Pitching Association in the US is very concerned with how a player rolls his shoulder to avoid rotator cuff injury." It turns out McIlroy has just returned from a specialist mocap center in the US, where his swing was being analyzed for even the tiniest inefficiencies.

This, in some ways, harks back to the origins of optical motion capture technology — as a clinical tool for gait analysis — but it may also hint at a possible future

A model tries out Nintendo's *Wii Fit*. PHOTOS: BLOOMBERG

so forth. This artificial evolution process resulted in biomechanically simulated stick figures that actually learned how to walk.

Applied to video games, this is leading to computer-controlled characters with genuine muscle and motor nervous systems, who are able to make their own in-game movement decisions. NaturalMotion has now developed its own American football sim, *Backbreaker*, that makes full use of this system. "Previously, athletes and their actions weren't simulated at all," says Reil. "They were just hollow skeletons playing back animation data. Our technology gives these athletes a physical body, awareness and motor control. In *Backbreaker*, players autonomously decide how to take their target down — we don't control it. One interesting consequence is that we've had to implement a real-world penalty system, which analyses the game as it unfolds because the computer players will try illegally to grab the facemasks of their opponents."

Meanwhile, back in the more serene atmosphere of Celtic Manor, what's interesting is how comfortable Rory McIlroy is with the mocap technology — if not the suit itself. Over multiple takes he's able, perfectly, and beautifully, to replicate his trademark swing, even though he doesn't usually compete in full Lycra bodysuits. Partly, this is down to training and muscle memory — the need to mechanically recall the perfect swing as a matter of routine. But there's something else: over the past decade, motion capture has also become a vital element of professional sport itself.

Nick Bolton explains: "We've got three systems up at Loughborough which are used by the sports science group and by the England Cricket Board — they're trying to achieve two things: performance optimization, making



The Sony PlayStation 3. PHOTOS: BLOOMBERG

use in video games. With camera-based control systems such as the Wii Remote and the forthcoming PlayStation Move and Microsoft Natal devices, games consoles can now view and record the users' own movements. Due out in December for the Xbox 360 console, Natal is perhaps the most ambitious, consisting of an array of sensors (including a camera and an infrared lens for depth perception) that sit below your TV and track your physical actions without the need for a handheld controller or joy pad. You'll be able to actually kick the ball in soccer sims, or cast a line in a fishing game, and, of course, you'll swing an imaginary golf club at a virtual ball. It's basic stuff beside what the Vicon cameras can capture, but comparisons between the two data sets are possible. It's likely, then, that we'll see games that take stats from McIlroy's swing and compare them with your own, showing where your technique is falling short, and allowing you to improve your real game while taking on the likes of Tiger Woods.

### The best games around

BY TOM LAMONT  
THE GUARDIAN, LONDON

#### 2010 FIFA World Cup South Africa

**PS3, Xbox 360, Nintendo Wii, PC**  
It is tempting to complain about EA's habit of releasing two or more iterations of its soccer games every year, forcing fans continually to shell out for updates. But EA's soccer games are generally too good to miss, both in terms of superficial polish (this version, released for the World Cup, includes great animations of real-life managers on the sidelines) and gameplay mechanics, better than any other on offer right now.

#### Wii Fit

##### Nintendo Wii

On paper it shouldn't have worked: give people an electronic board to stand on and make them do aerobics moves in their living room. But work it did, and *Wii Fit* — less a game, more an exercise guide — has been a huge hit since its release in 2008, adopted by institutions as varied as health clubs and military rehabilitation clinics.

#### Forza Motorsport 3

##### Xbox 360

A racing game of enormous scope, allowing you to burn around a dozen real-life tracks (plus more made-up ones) in everything from an Aston Martin to a Renault Twingo. Critics have praised its realistic physics: unlike games in which cars remain pristine from the beginning to the end of a race, Forza's vehicles get the hell beaten out of them and show it.

#### Punch Out!!

##### Nintendo Wii

Gratuitous exclamation marks aside, this update of an 1980s arcade boxing game is excellent. Making perfect use of the Wii's motion-sensor controls, players shadowbox in front of the screen, seeing their movements translated into uppercuts and jabs in the game. Tiring, but very, very fun.