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Irish researchers hope to put astronauts to sleep

It is tough to get a good night's sleep when you are an astronaut in orbit. There is no gravity to keep you in the bed and even worse, your system has to cope with 16 sunrises and 16 sunsets in a 24-hour day.

Two young researchers, from the University of Limerick and University College Dublin, hope to improve things for space travellers, however. They recently won an international competition that will see their unique sleep pattern experiment fly on board the International Space Station.

The quality of sleep, or more particularly the poor quality of it, is a major issue for Nasa and the European Space Agency, explains UL lecturer in the Department of Electronics and Computer Engineering and biomedical engineer Dr Derek O'Keeffe.

"Astronauts have a really difficult time sleeping," he says. Disturbed sleep isn't refreshing and leaves flight crews feeling sleep-deprived and less able to concentrate.

The current response is to give the crews sleeping pills, but there is very little data on how this enforced sleep compares with normal sleep on earth. The current method for gauging quality of sleep involves taking an electroencephalogram (EEG), a device which measures electrical activity in the brain, but the astronauts don't like the tight cap that must be worn to capture an EEG while in space.

Now O'Keeffe and his collaborator, final-year medical student at UCD Marc O'Gríofa, hope to greatly improve the situation with their experiment, Cardiac Adapted Sleep Parameter Electrocardiogram Recorder (Casper).

They met at a space medicine conference two years ago and discussed the problem before Marc came up with the idea of substituting an electrocardiogram (ECG), which measures electrical activity in the heart, for the EEG read-out to study sleep patterns.

"It is using an ECG signal as a surrogate marker for sleep," says O'Gríofa. His idea was that the astronaut could wear a shirt that would be able to pick up ECG signals from the heart but would be very comfortable to wear over long periods.

"The ECG has come to the fore in recent years as a very useful marker for sleep," he suggests. It is a "non invasive method for monitoring". When combined with analysis software, developed in collaboration with researchers in Harvard, it captures and studies the ECG signal to produce a "sleep spectrogram" measuring the quality of the astronaut's sleep.

Anyone who has suffered jet-lag after a long-distance flight and relocation in a different time zone is familiar with the sleep disturbance experienced by astronauts, the researchers say.

Our bodies have internal clocks working to a circadian rhythm that modulates hormone production, organ function and other bodily functions all through the day. This clock sets itself to the rise and fall of the sun.

Researchers have found that our circadian rhythm can deal with the kind of disturbance experienced by astronauts for as much as 100 days before the body can't cope any more and the rhythm goes seriously out of sync, says O'Griffo.

This spells trouble for long-distance space travel. "One of the big stumbling blocks of long distance space flight beyond the 100 days is the [circadian] pattern begins to deregulate," he says.

O'Keefe did the engineering spec for a proposed shirt, but their involvement in the competition changed when an ESA staffer spotted their entry and moved them into another competition and the possibility of flying their design on the ISS.

This left them with too little time to create their own shirt but they discovered a similar design known as the LifeShirt (www.vivometrics.com) which had just received FDA and other international approvals.

The availability of the shirt meant that their plans could be developed fast enough to enter and win the Success Special Opportunities Programme run by ESA. It has been selected as the European experiment to be flown on board the ISS next year and used by ESA astronaut Thomas Reiter, says O'Keefe.

He is scheduled to fly on the shuttle Discovery in late spring 2006, en route to the ISS. If the shuttle does not fly as planned then the Russians will fly Reiter up with the Irish experiment, which will spend 150 days in space before as return via Russian Soyuz.

Dick Ahlstrom

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