

Dead stars could be the future of spacecraft navigation

October 9 2012



A pulsar, a rapidly rotating neutron star, is the collapsed super-dense core of a massive star that has blown off its outer layers in a supernova. It casts out narrow beams of energy as it rotates. Credit: Victor Habbick, Visions/Science Photo Library

Scientists at the National Physical Laboratory (NPL) and the University of Leicester have been commissioned by the European Space Agency (ESA) to investigate the feasibility of using dead stars to navigate spacecraft in deep space. The findings of the research will advise ESA strategy and if feasible this technique may in future revolutionise the way spacecraft navigate in the outer Solar System and beyond.

Spacecraft navigation currently relies on [radio transmissions](#) between a distant craft and a network of ground-stations on Earth. This means that the craft has to wait for an instruction from Earth to guide it through space and with the large distances involved this could take hours, days or even longer. This time delay affects a spacecraft's ability to react rapidly according to its location. Furthermore, the ground infrastructure is increasingly difficult and expensive to maintain due to the size of the [radio antennas](#).

Scientists at NPL and the University of Leicester are exploring the use of X-rays from dead stars, called pulsars, to allow spacecraft to navigate autonomously. Pulsars are highly compact and rapidly [rotating neutron stars](#) that emit intense [electromagnetic radiation](#) observed as pulses, similar to the rotating beam of light seen from a light house. In some cases these pulses can be highly regular, making them suitable sources for navigation using a technique similar to GPS.

"Using on-board X-ray detectors, spacecraft could measure the times of pulses received from pulsars to determine the position and motion of the craft. The University of Leicester will use their experience in X-ray astronomy to come-up with potential designs of the device and NPL will develop timing and navigation algorithms to determine the potential accuracy of this technique. Funding received from ESA will allow us to investigate the feasibility of using these [dead stars](#) and the potential navigation performance that could be derived," says Setnam Shemar, leading the project on behalf of NPL's Time and Frequency Team.

The traditional form of ground-based space navigation can only support a limited number of spacecraft as only one set of measurements can be processed at any one time. If feasible, this new technique could allow a greater number of complex space missions to take place simultaneously in deep space as craft become capable of navigating themselves.

Results from the investigation will advise ESA on technical strategy and if successful, pulsar navigation could in the long-term reduce costs and limitations associated with ground-based technology. Such a method, using pulsars as nature's own GPS in space, might one day enable humanity to navigate far beyond the outer reaches of our Solar System.

Provided by National Physical Laboratory

Citation: Dead stars could be the future of spacecraft navigation (2012, October 9) retrieved 19 September 2024 from <https://phys.org/news/2012-10-dead-stars-future-spacecraft.html>

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