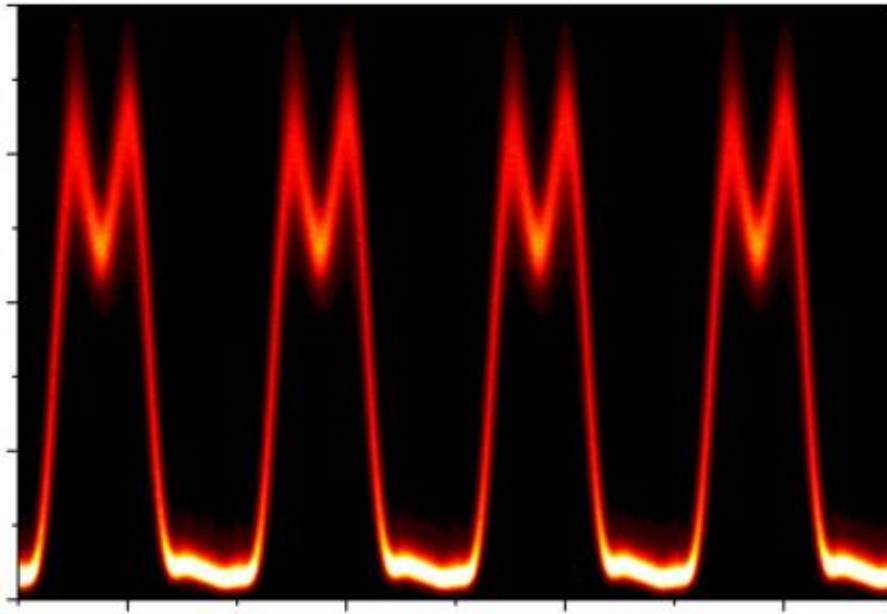


# New method to generate arbitrary optical pulses

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Example of custom-shaped pulses at 100-GHz repetition rate. Credit: University of Southampton

Scientists from the University of Southampton have developed a new technique to generate more powerful, more energy efficient and low-cost pulsed lasers.

The technique, which was developed by researchers from the

University's Optoelectronics Research Centre (ORC), has potential applications in a number of fields that use pulsed lasers including telecommunications, metrology, sensing and material processing.

Any application that requires optical pulses typically needs waveforms of a specific repetition rate, pulse duration, and pulse shape. It is often challenging to design and manufacture a laser with these parameters exactly as required. Even when a suitable solution exists, the size, the complexity and ease of operation of the laser are further critical considerations.

The new method works on a fundamentally different principle to existing pulsed lasers. It relies upon the coherent combination of multiple [semiconductor lasers](#), each operating continuous-wave at different precisely defined frequencies (wavelengths). Through the precise control of the amplitude and phase of each laser's output, it is possible to produce complex pulsed optical waveforms with a huge degree of user flexibility. The key to making the approach work is to phase-lock the semiconductor lasers to an optical frequency comb, which ensures the individual lasers have well-defined mutual coherence.

David Wu, lead author of the study and winner of the 2014 Engineering and Physical Sciences Research Council (EPSRC) ICT Pioneers award for this work, said: "As our new technique is based on a different approach to that currently used, it has several distinct features that are relevant in many applications. First, it is easily scalable - by combining a larger number of input lasers, shorter or more complicated-shape pulses and/or more power can be obtained. It can also generate pulses with a very low-level of noise (down to the quantum limit) and very high (greater than one THz) repetition frequencies.

"Finally, it consists of miniature and low-cost semiconductor lasers that can be all integrated on the same chip, making our pulse generator

potentially very compact, robust, energetically efficient, and low-cost."

Dr Radan Slavik, who leads the research group, added: "We believe that this work is likely to be of direct interest to scientists working in virtually any field of optics where pulsed [laser](#) sources are used. We also believe that the concept and phase-locking technology developed could be widely applicable with the broader optics/photonics community."

**More information:** The paper D. S. Wu, D. J. Richardson, and R. Slavík, 'Optical Fourier synthesis of high-repetition-rate pulses,' *Optica*, 2, 18-26 (2015) is available at: [www.opticsinfobase.org/optica/ ... fm?uri=optica-2-1-18](http://www.opticsinfobase.org/optica/fm?uri=optica-2-1-18)

Provided by University of Southampton

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