并行宽带复杂激光混沌信号的产生

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激光混沌信号具有类噪声、初始值敏感、宽带等特性，在保密光通信、高速随机数发生器、雷达探测、光子神经网络等领域有广泛应用前景。近年来，宽带复杂激光混沌信号源及其应用研究成为非线性光子学领域的国际研究热点。上述应用中，激光混沌信号的带宽和复杂度是决定其应用性能的核心指标。

电子科技大学邱昆教授、江宁教授等人提出了基于连续光激光器和自相位调制光注入外腔的并行混沌光信号产生方案，同时获得了两路具有低相关性的宽带复杂混沌信号。研究团队采用两个独立的激光源，利用相位调制的光谱展宽效应以及色散器件的相位-强度转换效应，设计了一种拥有两个独立并行输出的激光混沌系统，实验获得了两路带宽 24 GHz、互相关性低于 0.1 的复杂混沌光信号。他们详细分析了不同反馈强度条件下，两路并行混沌信号的带宽、复杂度及互相关性能，充分证明了通过该方案可以很方便地获得两路低相关宽带复杂混沌信号。与传统外腔半导体激光混沌信号产生方案相比，相同反馈条件下，该方案中任意输出支路混沌信号的带宽都得到了 2 倍以上的增强，且反馈时延特征被完全抑制隐藏，信号复杂度得到显著提升。此外，该方案具有良好的扩展性，通过进一步增加激光器数量，可实现多路低相关宽带复杂混沌信号产生。上述成果在多路高速保密光通信和多路物理随机数产生等领域具有广泛的应用前景。

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Parallel generation of wideband complex chaotic signals with low correlation

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Optical chaos has been widely applied in many fields such as secure optical communication, high-speed random number generator, radar and photonic neural network, because of its features of noise-like waveform, unpredictability, wideband spectrum, and etc. In these applications, the bandwidth and complexity of optical chaotic signal are the key indicators determining the application performance.

The research groups of Prof. Kun Qiu and Prof. Ning Jiang from the University of Electronic Science and Technology of China proposed a novel scheme for generating parallel wideband complex chaotic signals with low correlation, in virtue of continuous-wave laser and constant-amplitude self-phase-modulation injection. In this scheme, two independent lasers were used as the optical sources for chaos generation. By introducing a phase modulator and a dispersive component into the chaotic system and in virtue of the spectrum-broaden effect of the phase modulation and the phase-to-intensity conversion of dispersion, simultaneous generation of two wideband chaotic signals with bandwidths (80% power bandwidth) larger than 24 GHz and a cross-correlation coefficient lower than 0.1 were experimentally demonstrated. In comparison with the conventional external-cavity semiconductor laser-based optical chaos generation schemes, the bandwidths of the two simultaneously-generated chaotic signals in their scheme were enhanced by more than twice, and the characteristic of optical feedback delay was completely suppressed, as such the complexity was significantly improved.

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