2023「中技社科技獎學金」

2023 CTCI Foundation Science and Technology Scholarship

研究獎學金

Research Scholarship

Physics and applications of nonlinear dynamics in semiconductor lasers subject to modulated optical injection

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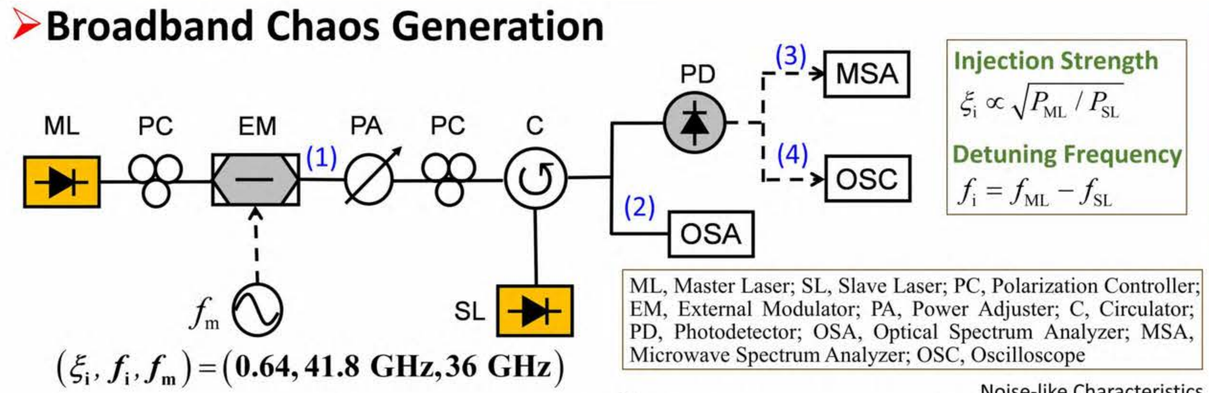
/研究重點/

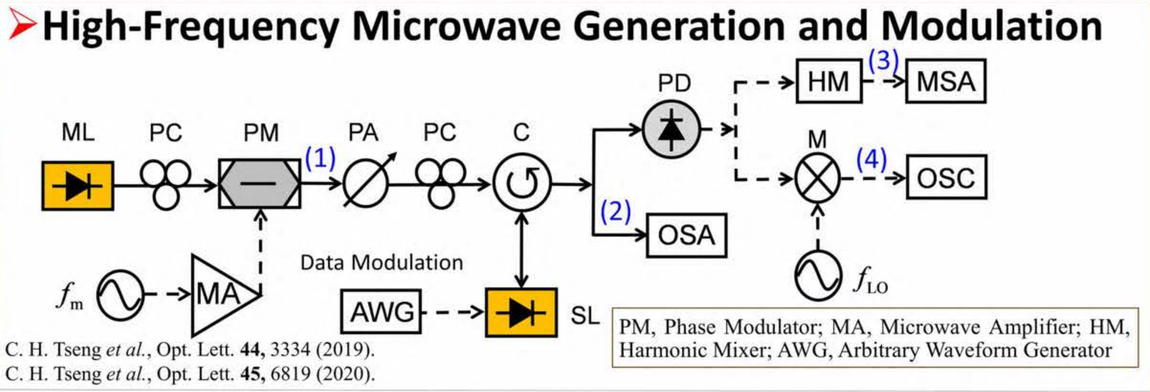
This dissertation investigates the nonlinear dynamics of semiconductor lasers subject to modulated optical injection. By leveraging their inherent dynamic properties, we propose innovative solutions for high-frequency communication systems, high-resolution radar systems, and true random number generation. Operating the system in period-one dynamics allows for stable single-tone microwave generation and data up-conversion from 40 to 110 GHz. It also enables FMCW microwave generation with a bandwidth exceeding 2.5 GHz within the same frequency band. When operating the system in chaotic dynamics, the generated chaotic source not only enhances radar range resolution to less than 1 cm but also facilitates the generation of true random bits at a rate of 320 Gbit/s. The advancements reported here have the potential to significantly enhance the performance of the Internet of Things.

/研究成果/

➢Broadband Chaos Generation

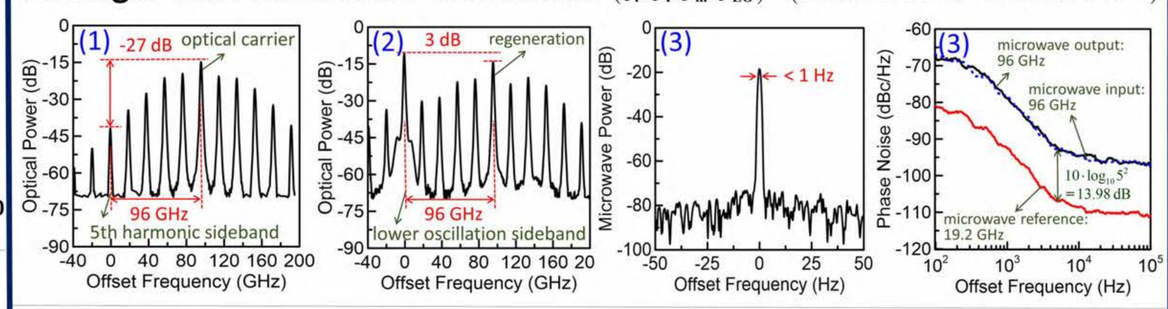


➢High-Frequency Microwave Generation and Modulation

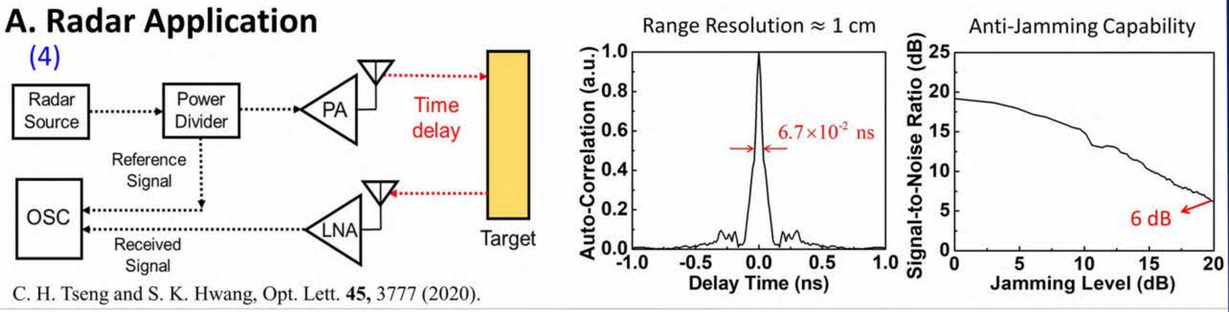


C. H. Tseng *et al.*, Opt. Lett. **44,** 3334 (2019).
C. H. Tseng *et al.*, Opt. Lett. **45,** 6819 (2020).

A. Single-Tone Microwave Generation $(\xi_i, f_i, f_m, f_{LO}) = (1.01, 95.4\ \text{GHz}, 19.2\ \text{GHz}, 96\ \text{GHz})$

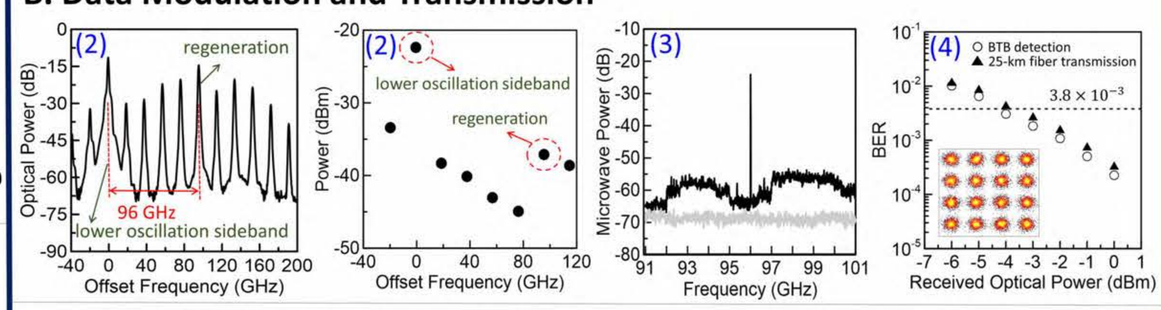


A. Radar Application

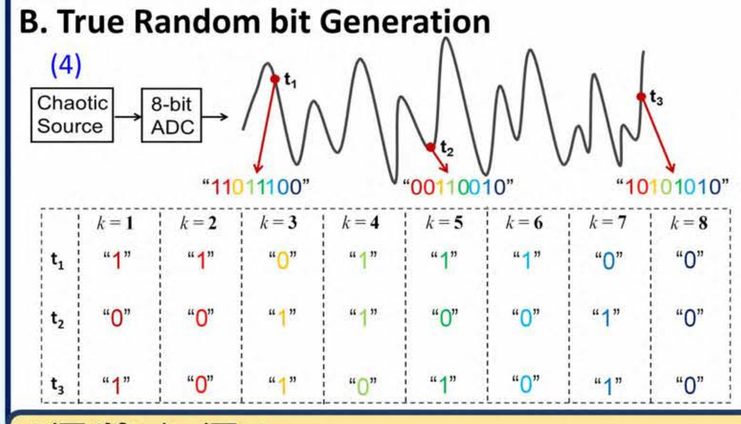


C. H. Tseng and S. K. Hwang, Opt. Lett. **45,** 3777 (2020).

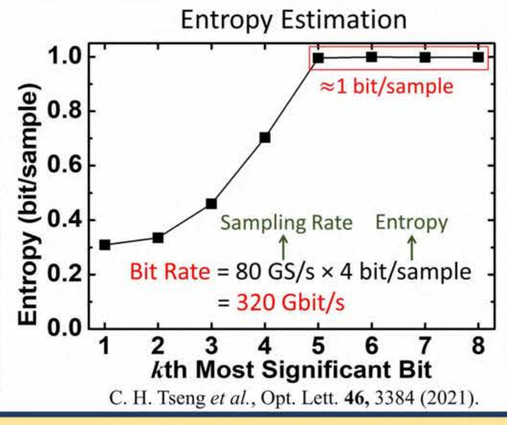
B. Data Modulation and Transmission



B. True Random bit Generation

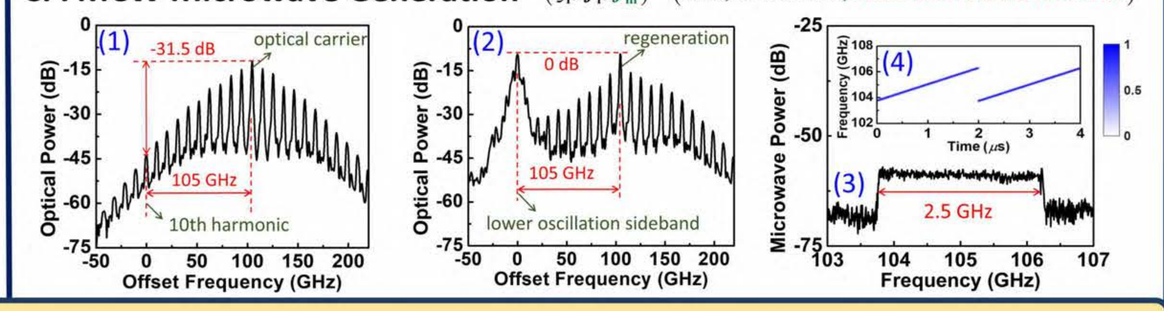


	$k=1$	$k=2$	$k=3$	$k=4$	$k=5$	$k=6$	$k=7$	$k=8$
t_1	"1"	"1"	"0"	"1"	"1"	"1"	"0"	"0"
t_2	"0"	"0"	"1"	"1"	"0"	"0"	"1"	"0"
t_3	"1"	"0"	"1"	"0"	"1"	"0"	"1"	"0"



C. H. Tseng *et al.*, Opt. Lett. **46,** 3384 (2021).

C. FMCW Microwave Generation $(\xi_i, f_i, f_m) = (1.33, 104.8\ \text{GHz}, \text{from } 10.375 \text{ to } 10.625\ \text{GHz})$



/得獎心得/

由衷感謝中技社對我的研究成果與學習表現給予肯定，使我有榮幸能獲得「中技社研究獎學金」的殊榮。萬分感謝指導教授黃勝廣博士對我研究上的訓練與指導，使我從中培養出獨立思考與解決問題的能力。同時感謝實驗室的夥伴與家人們在我求學過程中的相互討論與陪伴，使我在面對逆境時能更有信心。期許自己未來有更豐富的研究成果。