Numerical modeling of the generation of a Kerr comb in a coupled cavity system using coupled mode equations

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Abstract

We show the modeling of Kerr comb generation in a coupled cavity system and perform a numerical simulation in a normal dispersion regime. We show the repetition rate is selectable and soliton generation is possible.

Background

✓ Kerr comb

Laser → Microcavity → OSA

OSA: optical spectrum analyzer

Objective

Perform a Kerr comb simulation of coupled microcavities by using coupled mode theory (CMT)

Simulation method

Coupled mode equations (one equation per resonant frequency)

Calculating normalized equations with FFT*


Merit (compared with NLSE)

✓ Accurate calculation
✓ Flexible simulation (e.g. with different cavities with 3 or more cavities)

Especially in coupled cavities,
✓ Correct coupling strength

Simulation results

✓ Dark soliton descending soliton step

SIN microrings

SIN microrings

Pump power: 0.4 W

Center frequency: 193 THz

Second-order dispersion (β2): 186.9 ps²/km

Q factor: 8.6 × 10⁶

Round-trip time: 4.32 ps

✓ Platicon-like dark soliton (Wide valley dark soliton)

Detuning

Intracavity power

Optical spectrum (dB)

Fiber

Laser

For Kerr comb generation: 


Conclusion

✓ Modeled coupled microcavity system with CMT.
✓ Successful generation of dark soliton pulses with accurate modeling.

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