

Fourier Transform Optical Pulse Shaping Using a Single Chirped Fiber Bragg Grating

Chao Wang and Jianping Yao

Microwave Photonics Research Laboratory, University of Ottawa, Ottawa, ON K1N 6N5, Canada

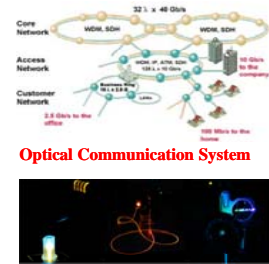
1. INTRODUCTION

A. Why Ultra-short pulse shaping?

- Optical pulse shaping technology enables highly complex structuring of ultrafast optical signals, both in frequency-domain and time-domain.
- Applications:



Optical Computing System



Optical Communication System



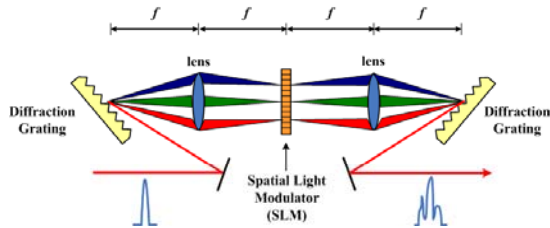
Optical Signal Processing

B. How to shape ultra-short optical pulse?

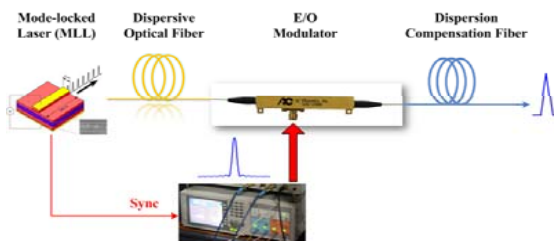
- Fourier synthesis (Fourier transform pulse shaping)



Spatial-domain pulse shaping:



Time-domain pulse shaping:

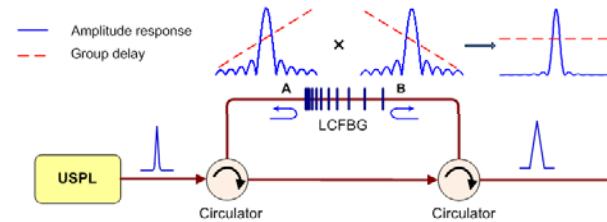


Proposed method: Using one single Linearly-chirped FBG

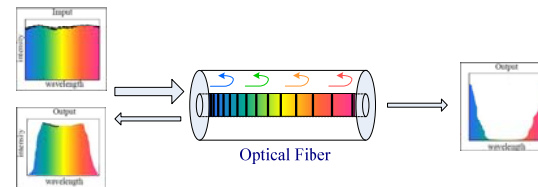
- Align-free, Synchronization-free
- Smaller size, lower loss
- Potential for integration

2. PRINCIPLE

- Fourier transform pulse shaping system using a single linearly-chirped fiber Bragg grating.



- Linearly-chirped fiber Bragg grating (LC-FBG)

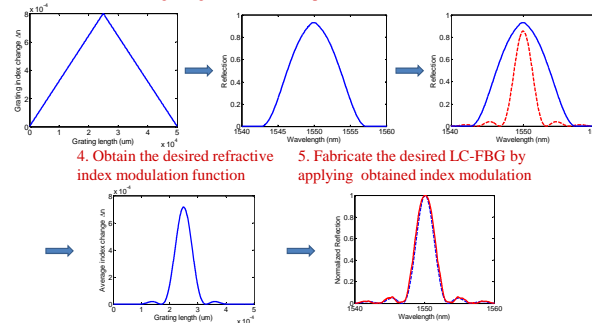


- Broadband reflector, reflection response can be tailored.
- Linear group delay response, complementary dispersions from opposite sides.

3. FBG DESIGN AND FABRICATION

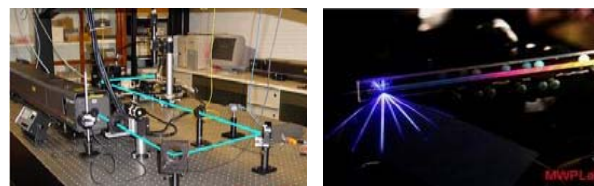
- FBG Design and Fabrication Procedure (Shown with simulation results)

- Apply a symmetric linear index modulation to write a test grating
- Measure the test grating reflection response
- Compare the target reflection with the measured reflection



- Obtain the desired refractive index modulation function
- Fabricate the desired LC-FBG by applying obtained index modulation

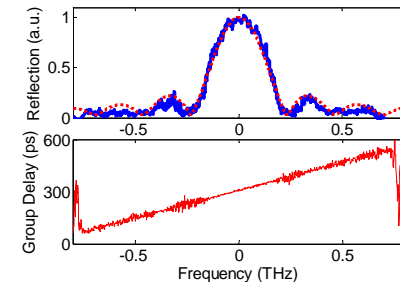
- FBG Fabrication Facility



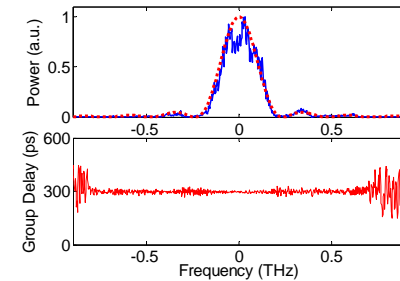
4. EXPERIMENTAL RESULTS

Synthesis of ultrashort triangular optical pulse

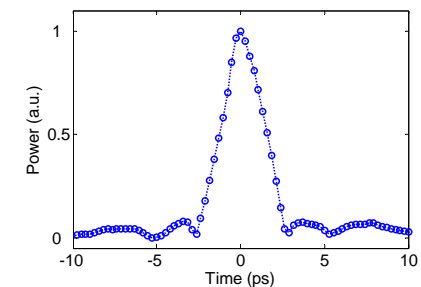
- Reflection spectrum and group delay response of the fabricated LC-FBG.



- Spectral response of the entire pulse shaping system.



- Synthesized triangular optical pulse:



5. CONCLUSION

- A new Fourier-transform pulse shaping system using a single LC-FBG was proposed and experimentally demonstrated.
- The use of a single LC-FBG guarantees an exact cancellation of the dispersions, featuring a simplified structure and a better pulse shaping accuracy.
- A simple and effective method was proposed to design the LC-FBG with an arbitrary spectral response.

