# Multiprocessing-Enhanced Parallelization for LSB Image-in-Image Steganography

Faculty of Computer Sciences & Engineering,
St Cyril and Methodius University, Skopje

Andrea Stevanoska 226001

What is steganography?

▸ **Definition:** The practice of hiding information within other data (e.g., images, audio, video).

▸ Used for secure communication and data protection.

▸ **Image Steganography:** Hiding data within images in a way that is imperceptible to the human eye.

▸ **LSB technique** replaces the least significant bits of an image's pixel values with the most significant bits of the secret image's pixels.
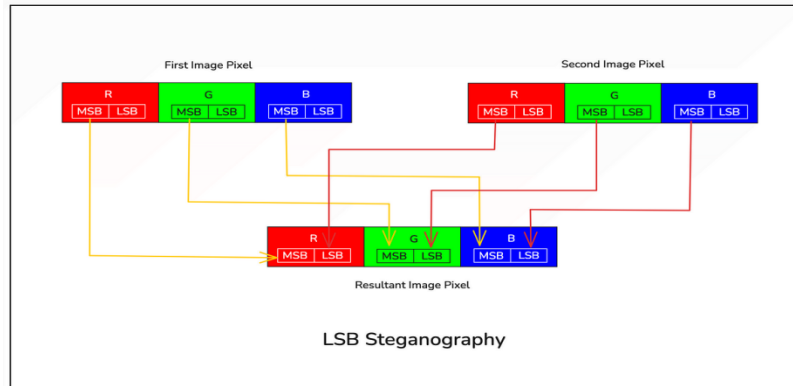
LSB Steganography

Original image - before hiding
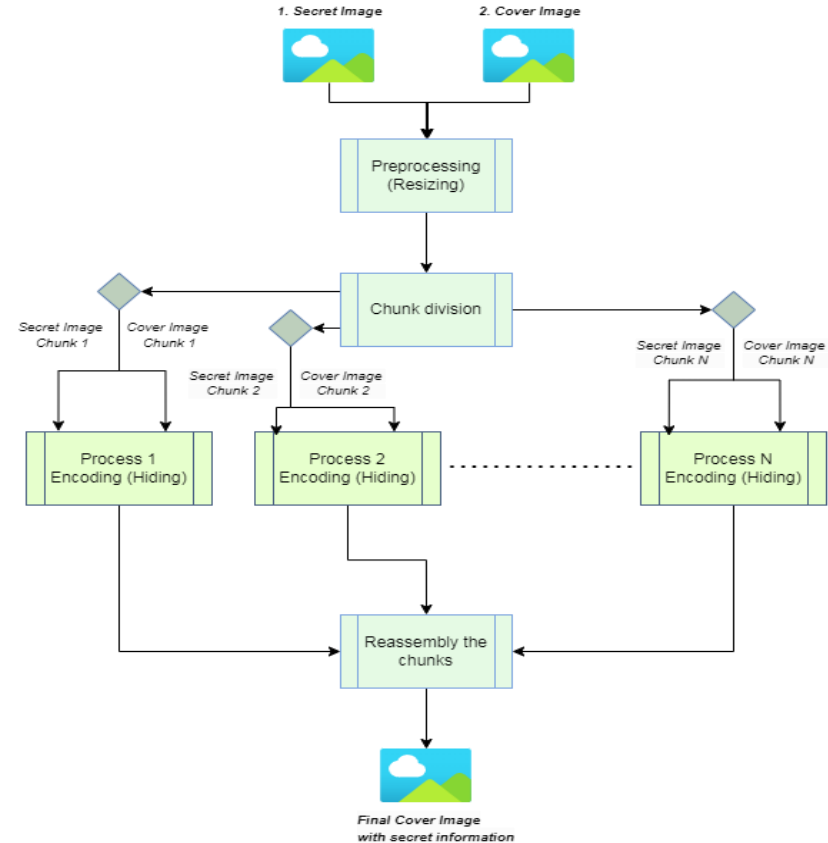
Secret image

Secret holder image

Extracted image

Motivation

- Challenges with traditional sequential LSB
- Enabling faster image steganography encoding and decoding.
- Starter Questions:
  - Does a parallelized approach significantly reduce encoding and decoding time compared to sequential processing?
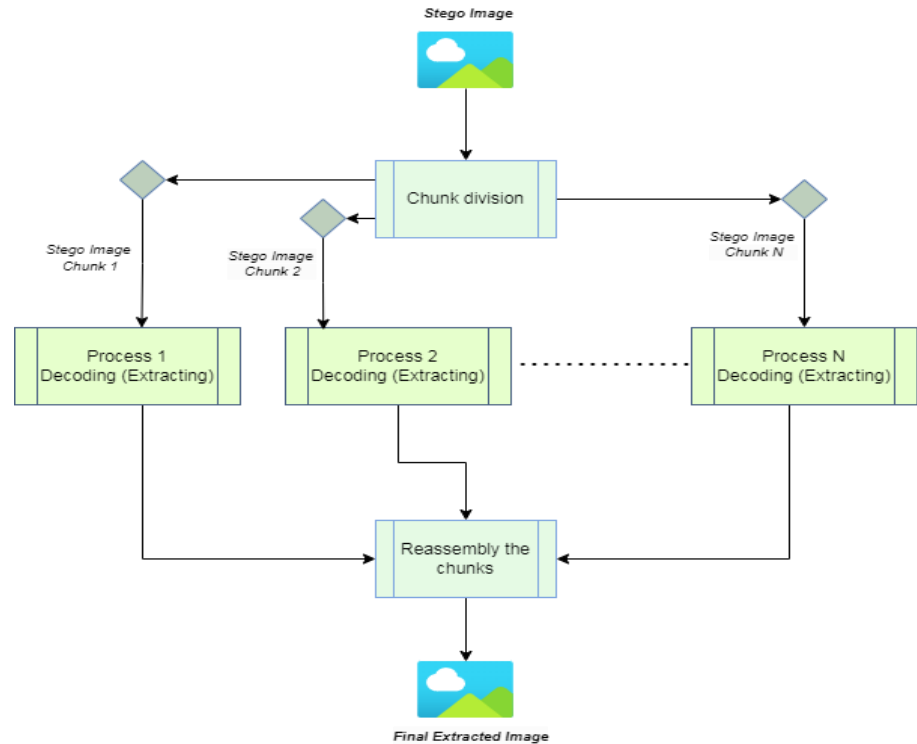 - Do the final images have the same quality as in the non-parallel approach?
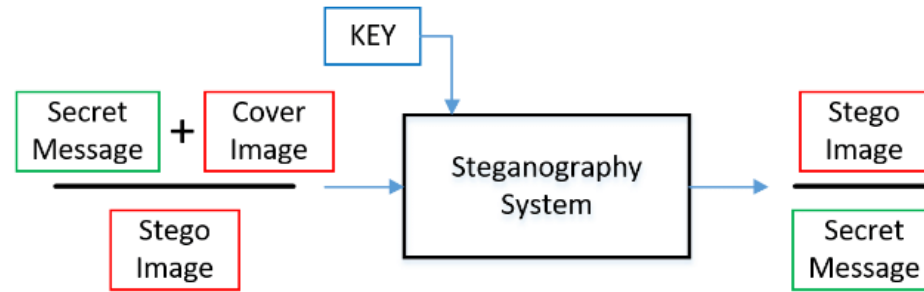
Solution Architecture 1.0

- *Sequential Approach – one pixel at a time*
- Parallel Approach: **Encoding**
- Preprocessing
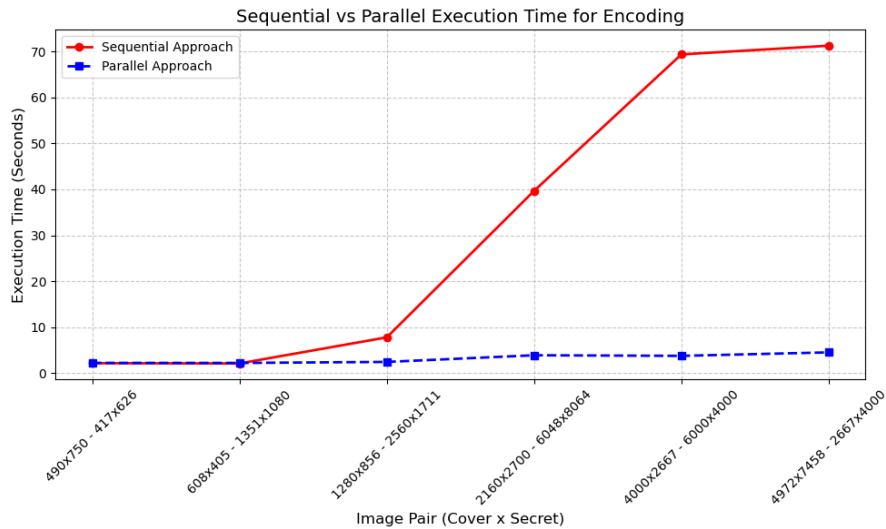- Chunk division
- Encoding each pair of chunks
- Reconstruction

Solution Architecture 2.0

- ▸ Parallel Approach: **Decoding**
- ▸ Chunk division
- ▸ Decoding each chunk
- ▸ Reconstruction

Results 1.0

- Encoding Performance Analysis
- Speedup = Sequential Time / Parallel Time

Sequential vs Parallel Execution Time for Encoding

		Encoding		
Cover Image Size	Secret Image Size	Sequential Time (s)	Parallel Time (s)	Speedup (Sequential/Parallel)
490x750	417x626	2,16	2,23	0,9686
608x405	1351x1080	2,11	2,22	0,9505
1280x856	2560x1711	7,79	2,44	3,1926
2160x2700	6048x8064	39,67	3,89	10,1979
4000x2667	6000x4000	69,38	3,76	18,4521
4972x7458	2667x4000	71,27	4,52	15,7677

Results 2.0

▸ Decoding Performance Analysis

▸ Speedup = Sequential Time / Parallel Time

Sequential vs Parallel Times for Decoding
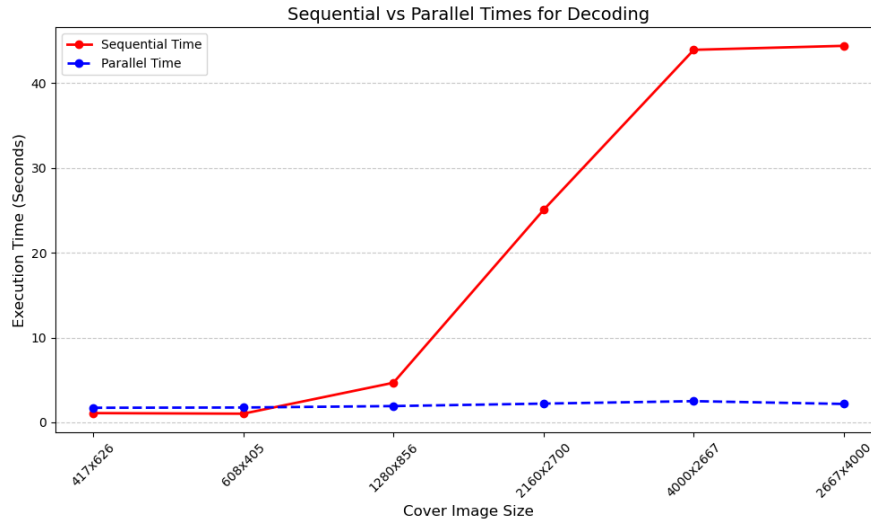
Decoding			
Stego Image Size	Sequential Time (s)	Parallel Time (s)	Speedup (Sequential/Parallel)
417x626	1,09	1,72	0,6337
608x405	1,02	1,75	0,5829
1280x856	4,67	1,92	2,4323
2160x2700	25,06	2,21	11,3394
4000x2667	43,93	2,50	17,5720
2667x4000	44,40	2,17	20,4608

Results 3.0

▸ Speedup plots side by side
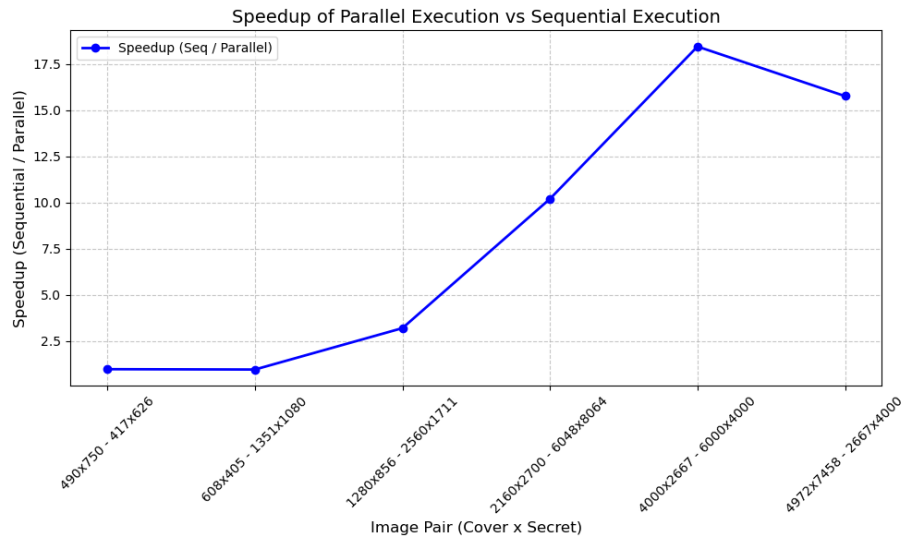
Encoding Speedup
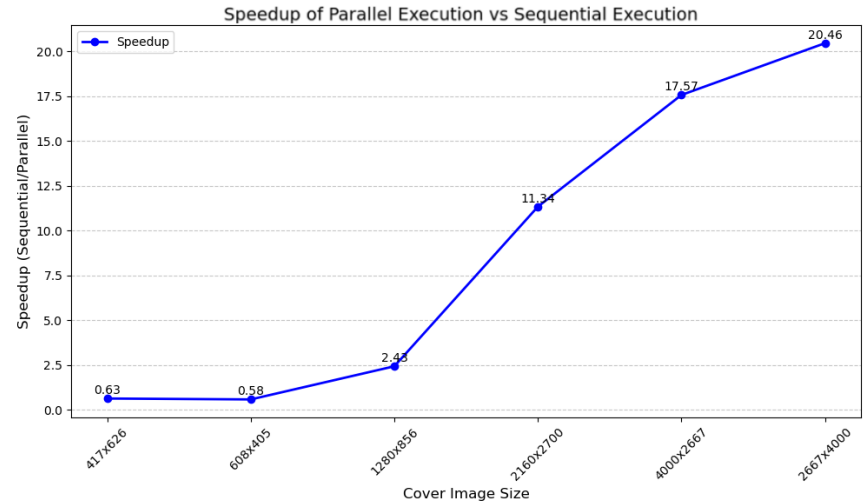
Decoding Speedup

Conclusion

- **Conclusion:** Parallelization improves efficiency while maintaining image quality.
- Up to 17 times faster for encoding and 20 times for decoding.
- **Future Work:**
  - Explore distributed computing frameworks for large-scale applications.

Thank you for your attention!