

# Satellite Image Interpolation: A State-of-the-art Review

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**In-class Presentation (Assignment 01)**

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# Outline

- ▶ Problem definition and issues
- ▶ Goals of the review
- ▶ Literature review
- ▶ Experimental setup
- ▶ Performance summary
- ▶ Future directions
- ▶ Conclusion
- ▶ References



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# Problem Definition and Issues

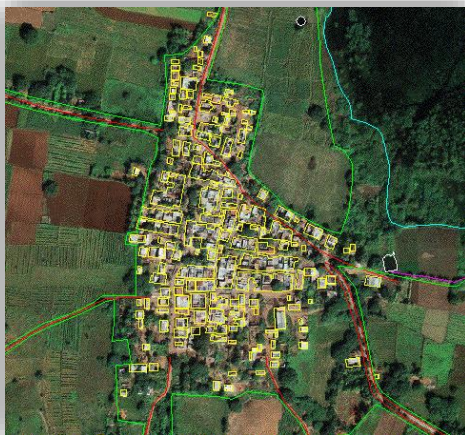


1. *Why we need to enhance the resolution of a satellite image?*



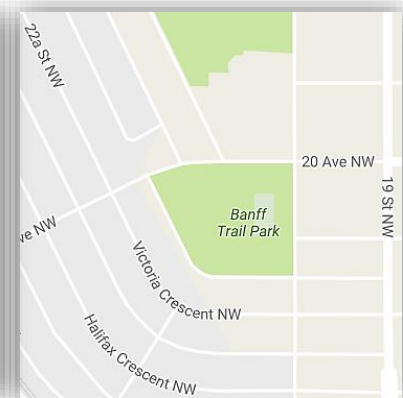
Primary demand before processing

- Distance (area covered) and level of details
- Sensor limitation (Resolution trade-off)
- GIS application necessity



[a]

Earth surface object detection



[d]

Raster to vector conversion



# Problem Definition and Issues



2. *What makes the satellite image interpolation a challenging research topic?*



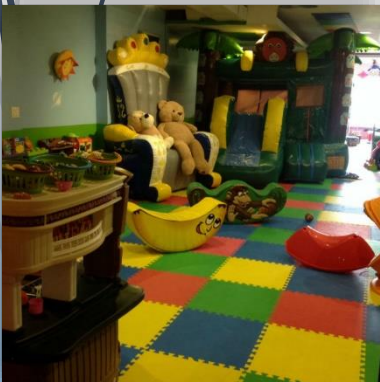
➤ Conventional methods

- Nearest-neighbor interpolation
- Bilinear interpolation
- Bicubic interpolation

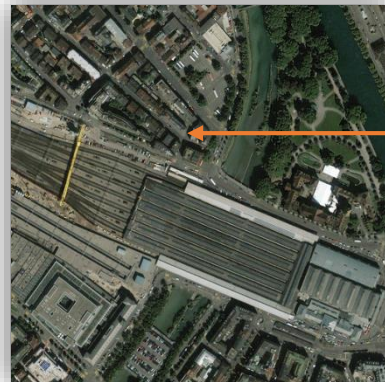
Not good for satellite image interpolation

# Why?

Indoor image



Satellite image



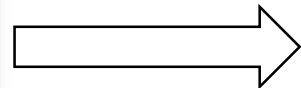
Contain lots of tiny objects (increase high frequency components such as edges, lines, points)



# Experimental setup

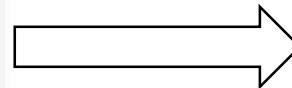
Original High Resolution

[a]



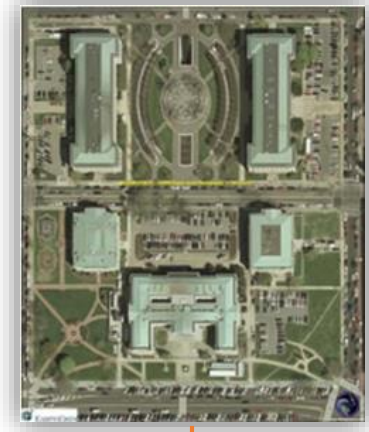
Down sampling  
by 2 or 4

Generated Low Resolution



Satellite image  
Interpolation with  
factor 2 or 4

Generated High Resolution



Difference Image



**Subjective comparison:**

Absolute Difference image

**Objective comparison:**

Root Mean Square Error (RMSE)

or

Peak Signal to Noise Ratio (PSNR)



# Performance summary

Method (Year)	Comments	Database
[1] (1991)	Outperforms conventional techniques only	4 benchmark images (Lena, Baboon, Elaine and Peppers)
[2] (2005)	Outperforms conventional techniques only	4 benchmark images (Lena, Baboon, Elaine and Peppers)
[3] (2010)	Outperforms conventional techniques and [1]	5 images from Satellite imaging corporation [9]
[4] (2011)	Outperforms conventional techniques and [2]	5 images from Satellite imaging corporation [9]
[5] (2011)	Outperforms conventional techniques, [2] and [4]	5 images from Satellite imaging corporation [9]
[6] (2013)	Outperforms conventional techniques, [3], [4] and [5]	5 images from Satellite imaging corporation [9]
[7] (2015)	Outperforms WZP, [2], and [4]	4 images from LandSat 8 [10]
[8] (2015)	Not reported, compare among different types of wavelet functions	4 images from LandSat 8 [10]



# Conclusion

- ▶ Discuss the applications and challenges of satellite image interpolation
- ▶ Briefly explain the general concept of frequency component aware interpolation.
- ▶ Present few prominent state-of-the-art methods of satellite image interpolation
- ▶ Discuss performance and methodological comparison



# References

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2. Temizel, A. and Vlachos, T. (2005). Image resolution upscaling in the wavelet domain using directional cycle spinning. *Journal of Electronic Imaging*, 14(4), pp.4051-4562.
3. Demirel, H. and Anbarjafari, G. (2010). Satellite image resolution enhancement using complex wavelet transform. *IEEE geoscience and remote sensing letters*, 7(1), pp.123-126.
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7. Jadhav, B. D. and Patil, P. M. (2015, May). An effective method for satellite image enhancement. *International Conference on Computing, Communication and Automation (ICCCA)*, 2015, pp.1171-1175, IEEE.
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