Image Registration: Introduction

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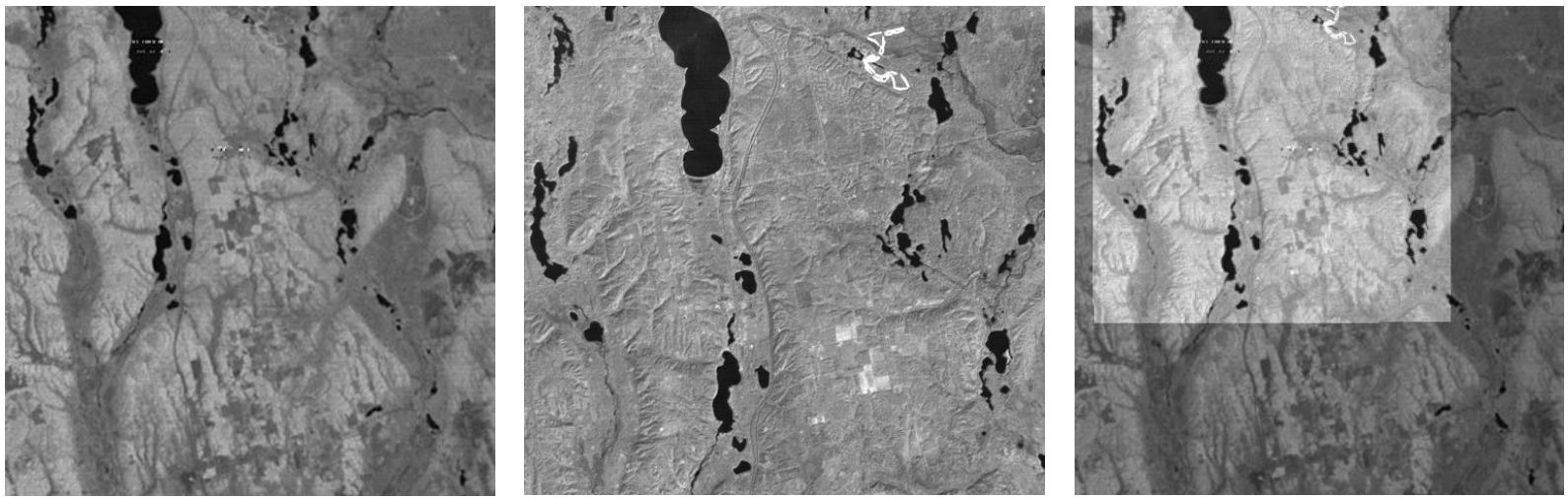
What is image registration?

- It is the process of spatially aligning two images of a scene.
- An example:



Terminologies

- **Reference or source image:** This is the image that is kept unchanged and is used as the reference.
- **Sensed or target image**: This is the image that is geometrically transformed to spatially align with the reference image.
- **Transformation or warping function:** This is the function used to warp the sensed image to take the geometry of the reference image.

Steps in image registration

1. **Preprocessing:** Image smoothing, deblurring, edge sharpening, image segmentation, edge detection.
2. **Feature selection**: Extracting points, lines, regions, templates, etc. from an image.
3. **Feature correspondence:** Determining the correspondence between features in two images.

Steps in image registration

4. **Determining the transformation function**: From the coordinates of corresponding points determining the transformation function.
5. **Resampling**: Resampling the sensed image to the coordinate system of the reference image using the transformation function.

Applications

- Change detection
- Image fusion
- Target recognition
- Target localization
- Depth perception
- Image mosaicing
- Motion estimation

References

1. *2-D and 3-D Image Registration*, A. Goshtasby, John Wiley & Sons, late 2003 or early 2004.
2. *Medical Image Registration*, J. V. Hajnal, D. L. G. Hill, and D. J. Hawkes (Eds.), CRS Press, 2001.
3. *Landmark-Based Image Analysis: Using Geometric and Intensity Models*, K. Rohr, Kluwer Academic Publishers, Boston, MA, 2001.
4. *Handbook of Medical Imaging*, vol. 2, M. Sonka and J. M. Fitzpatrick (Eds.), "Image Registration," SPIE Press, 447–506, 2000.
5. *Image Registration*, A. Goshtasby and J. LeMoigne (Eds.), a special issue of *Pattern Recognition*, Jan. 1999.
6. *Biomedical Image Registration*, F. Pernus, S. H. Siegfried, and M. Vierveger (Eds.), a special issue of *Image and Vision Computing*, January 2001.
7. *Non-Rigid Image Registration*, A. Goshtasby, L. Staib, C. Studholme, and D. Terzopoulos (Eds.), a special issue of *Computer Vision and Image Understanding*, Feb. 2003.
8. *Image Registration*, J. P. W. Pluim and J. M. Fitzpatrick (Eds.), a special issue of *IEEE Trans. Medical Imaging*, Nov. 2003.

Course outline

1. Introduction (A. Goshtasby): 10 min
2. Feature extraction (K. Rohr): 50 min
3. Feature correspondence (G. Stockman): 50 min

   Break: 15 min
4. Transformation functions (A. Goshtasby): 60 min
5. Validation methods (A. Goshtasby): 15 min
6. Summary (A. Goshtasby): 10 min
7. Questions and answers (Rohr, Stockman, Goshtasby): 20 min