Graph Matching based on dot product representation of graphs

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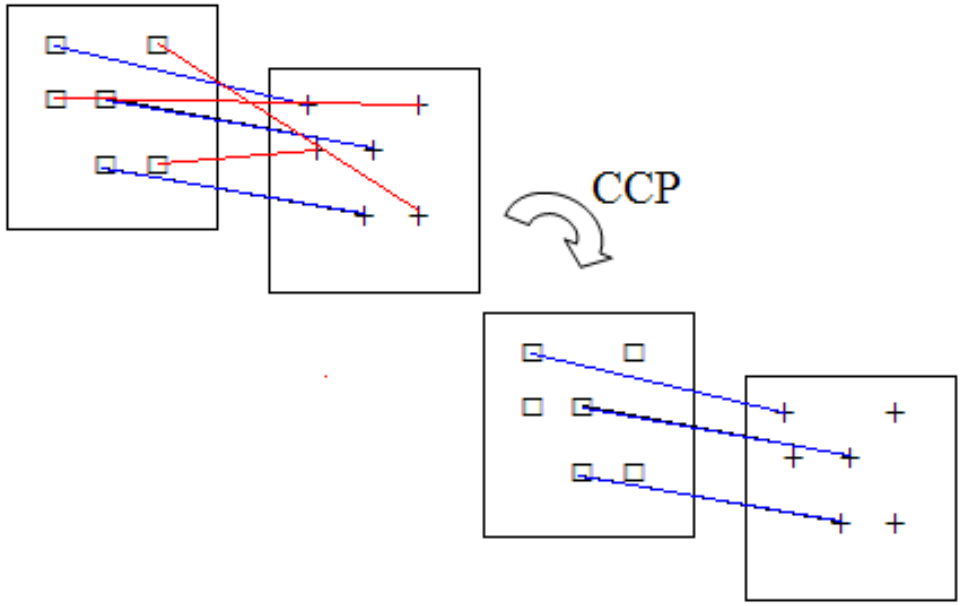
Main idea

- We render the graph matching process to a way of recovery missing data based on dot product representation of graph (DPRG).
- **Main steps**

1. Initialization (Consistency check process)
2. Association graph (Unobserved network)
3. Missing value recovery (DPRG)
4. Finding Correspondences (Hungarian)

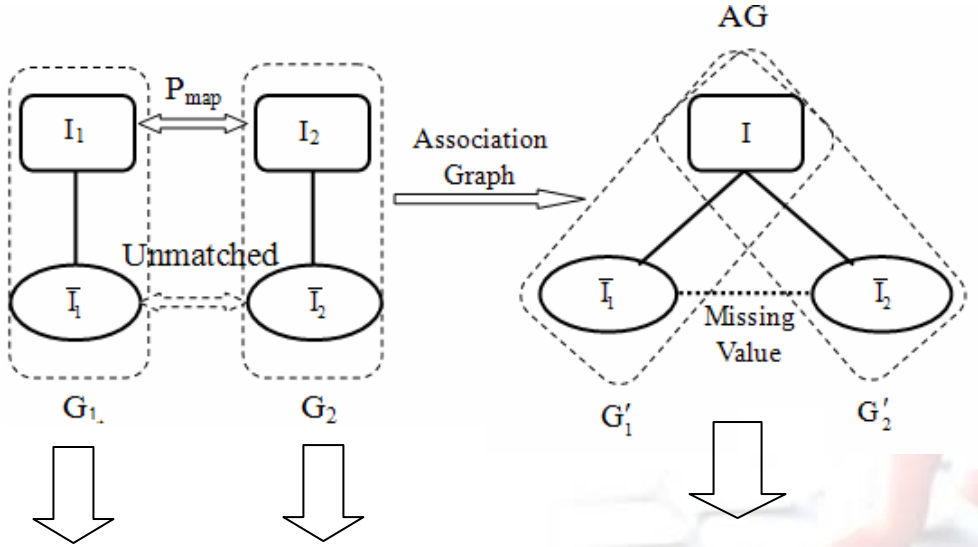
Consistency Check Process (CCP)

- **Purpose:** CCP is designed to remove the false correspondences and obtain positive correspondences from the initial correspondences.



Association Graph (AG)

➢ Association Graph



$$A_{G_1}=\begin{bmatrix} A_{I_1} & B_1 \\ B_1^{T} & C_1 \end{bmatrix} \quad A_{G_2}=\begin{bmatrix} A_{I_2} & B_2 \\ B_2^{T} & C_2 \end{bmatrix} \quad A_{AG}=\begin{bmatrix} A_I & B_1 & B_2 \\ B_1^{T} & C_1 & O \\ B_2^{T} & O & C_2 \end{bmatrix} \quad A_I=\frac{1}{2}(A_{I_1}+A_{I_2})$$

Association Graph (AG)

- **AG:** An incompletely observed network
- **Unobserved links:** Corresponding relationship between nodes that are not yet matched.
- **Recovery (DPRG with missing value):**

$$\text{Minimize } f(X) = \left\| X^T X - \mathrm{A}_{\mathrm{AG}} - \mathrm{M} \circ (X^T X) \right\|_F^2$$

M is the missing value label matrix

- **AG integrates both positive correspondences and two graphs at the same time.**

Graph Matching based on DPRG

➢ Matching method

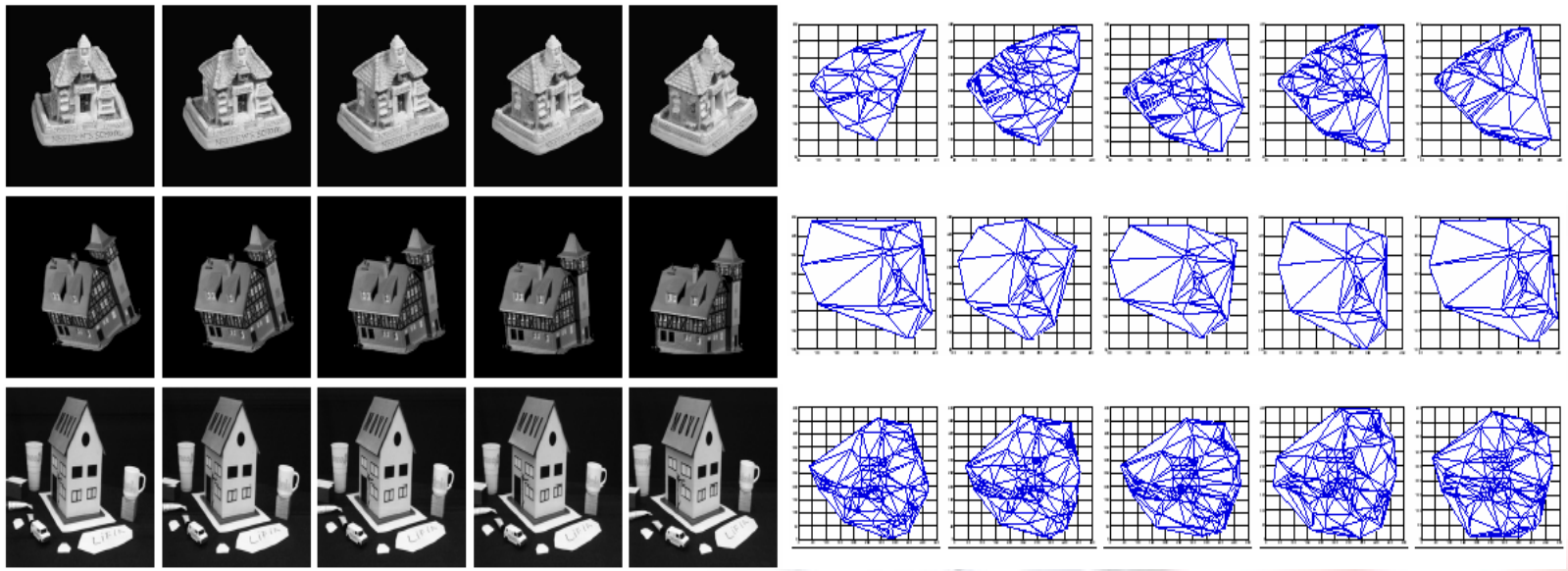
The **correspondence cost** between nodes in two graphs can be seen as the missing value for them in AG. The missing value can be obtained by solving the following problem

$$\text{Minimize } f(X) = \left\| X^T X - \mathrm{A}_{\mathrm{AG}} - \mathrm{M} \circ (X^T X) \right\|_F^2$$

➢ **The matching can be achieved by using Hungarian, SVD algorithms and so on.**

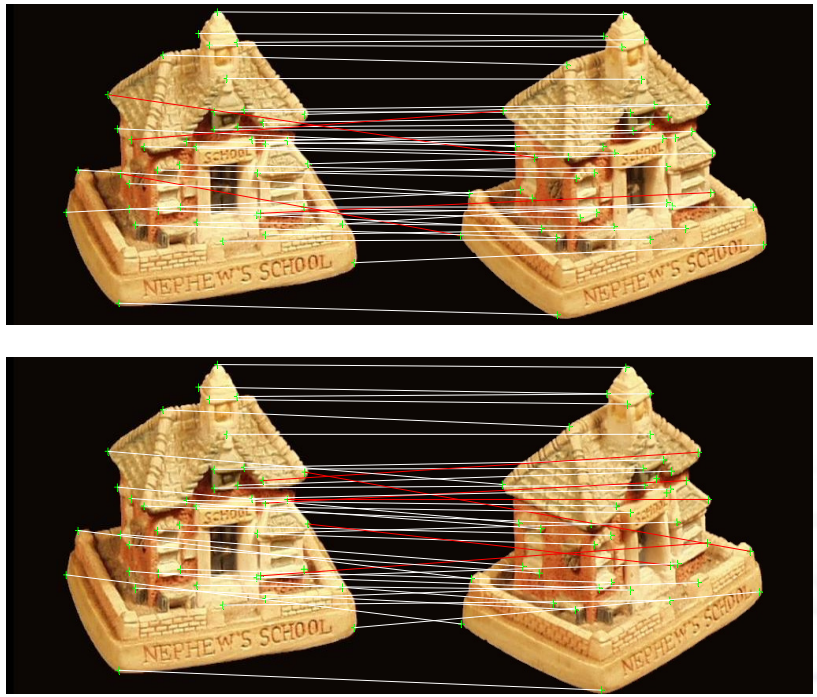
Experiments

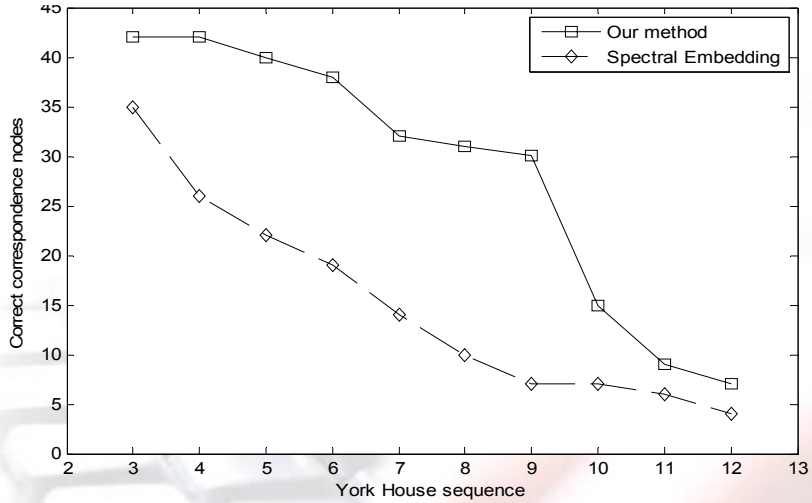
- **Images and Delaunary Graphs**



Experiments

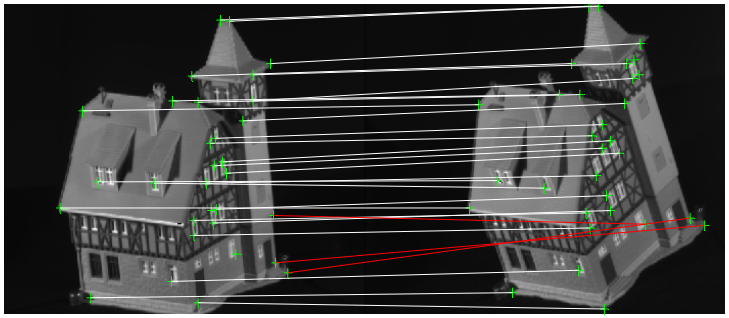
➢ Experimental results on York house images

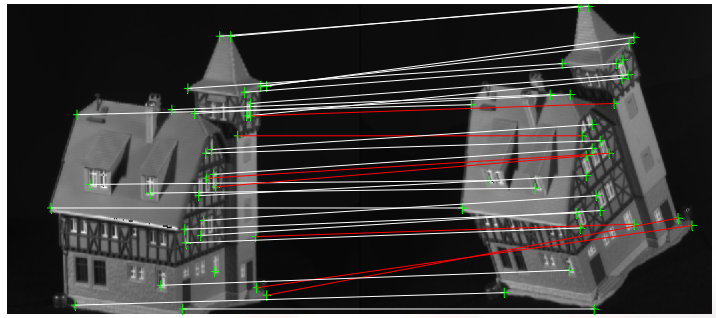




Experiments

➢ Experimental results on CMU images





Images	Points	methods	Correct correspondences	False correspondences	No correspondences
house1	30	EM	-	-	-
		DPRG	-	-	-
house2	32	EM	28	1	1
		DPRG	28	1	1
house3	31	EM	23	5	2
		DPRG	25	3	2
house4	30	EM	11	10	9
		DPRG	22	4	4
house5	30	EM	5	16	9
		DPRG	19	7	4

Thank you !