MORPHOLOGICAL APPROACH FOR TEMPLATE MATCHING

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Template matching algorithm

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INTRODUCTION

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Template–matching (area based approach)

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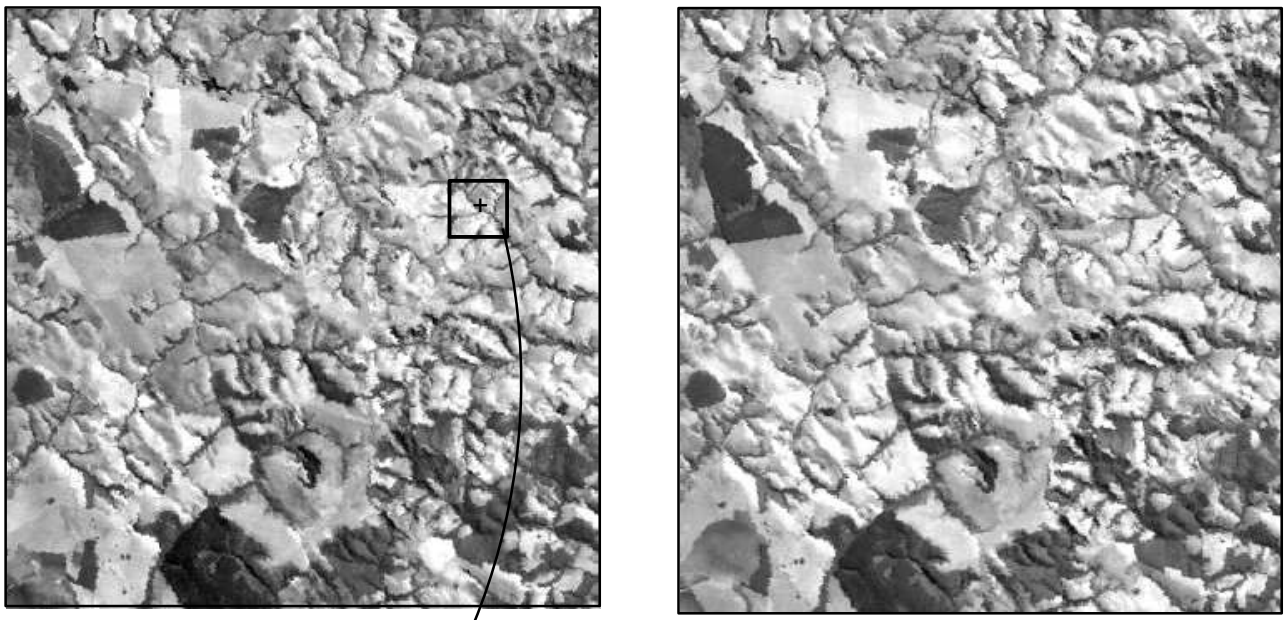
Finding out in a *search image* the *location* of a *template*.



Template

Search image

INTRODUCTION

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VECTOR SPACE APPROACH

Euclidian norm $\Rightarrow$ Sum of products (correlation)

l_1 norm $\Rightarrow$ Sum of minima (morphological correlation)
(Maragos 1988)

NONLINEAR APPROACH

Template extraction characterization $\Rightarrow$ Inf separable operator
(Ronse 1996)

Sum of a gray–scale erosion and gray–scale anti–dilation
(Khosravi & Schafer 1996)

TEMPLATE MATCHING ALGORITHM

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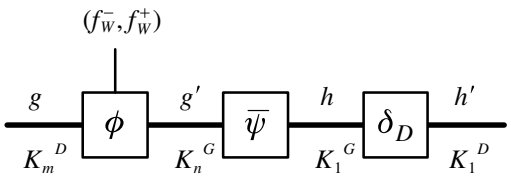

$$\text{Let } K_m = [0,m] \quad \text{and} \quad n = \#W$$

$$f_W^-(x) \triangleq \max\{0,\ \min\{m,\ f_W(x) + c_1\}\}$$
$$f_W^+(x) \triangleq \max\{0,\ \min\{m,\ f_W(x) + c_2\}\}$$

$$\phi \triangleq \sum_{i \in \mathbf{n}} \lambda^i \quad \text{where} \quad \lambda^i \triangleq \varepsilon^i_{f_W^-(w_i)} \wedge \delta^{ai}_{f_W^+(w_i)}$$

$$\varepsilon_l{}^i(g)(x) \triangleq \begin{cases} 1 & \text{if } g(x + w_i) \geq l \\ 0 & \text{otherwise} \end{cases} \quad \text{and} \quad \delta_l{}^{ai}(g)(x) \triangleq \begin{cases} 1 & \text{if } g(x + w_i) \leq l \\ 0 & \text{otherwise} \end{cases}$$

Equivalently,

$$\phi(g)(x) = \#\{i \in \mathbf{n} : g(x + w_i) \in [f_W^-(w_i), f_W^+(w_i)]\}$$

TEMPLATE MATCHING ALGORITHM

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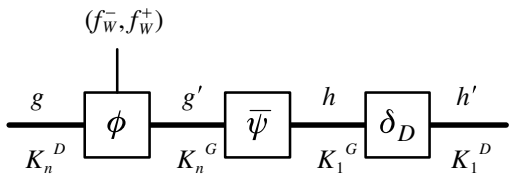

$$\overline{\psi} \triangleq \bigvee_{l=0,\ldots,n} \lambda_l \quad \text{where } \lambda_l \triangleq \varepsilon_l \wedge \delta^{\mathrm{a}}{}_l$$

$$\delta_l(f)(x) \triangleq \begin{cases} 1 & \text{if } f(x) > l \\ 0 & \text{otherwise} \end{cases} \quad \text{and} \quad \varepsilon_l(f)(x) \triangleq \begin{cases} 1 & \text{if } f(x) \geq l \\ 0 & \text{otherwise} \end{cases}$$

$$\delta^{\mathrm{a}}{}_l \triangleq \delta_G{}^{\mathrm{a}} \circ \delta_l$$

$$\delta_G{}^{\mathrm{a}}(f) \triangleq \begin{cases} 1_G & \text{if } f = 0_G \\ 0_G & \text{otherwise} \end{cases}$$

Equivalently,

$$\overline{\psi}(g')(x) = \begin{cases} 1 & \text{if } g'(y) \leq g'(x) \quad (y \in G) \\ 0 & \text{otherwise} \end{cases}$$

NUMERICAL EXAMPLE

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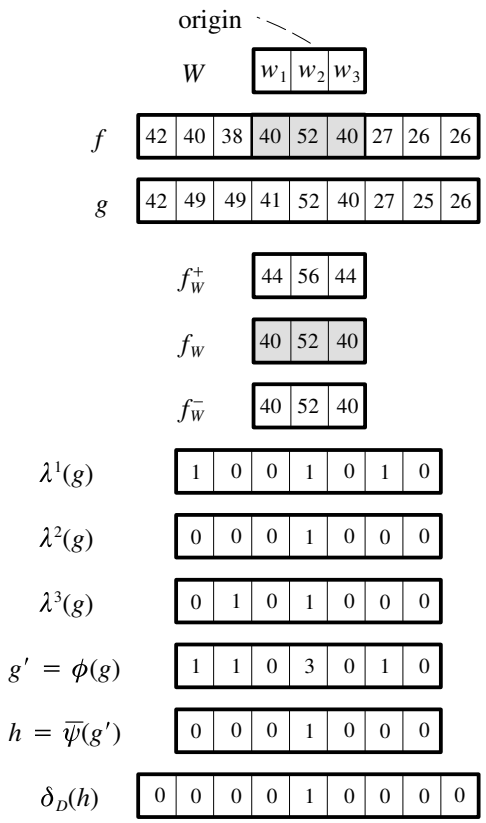

EXPERIMENTAL RESULT

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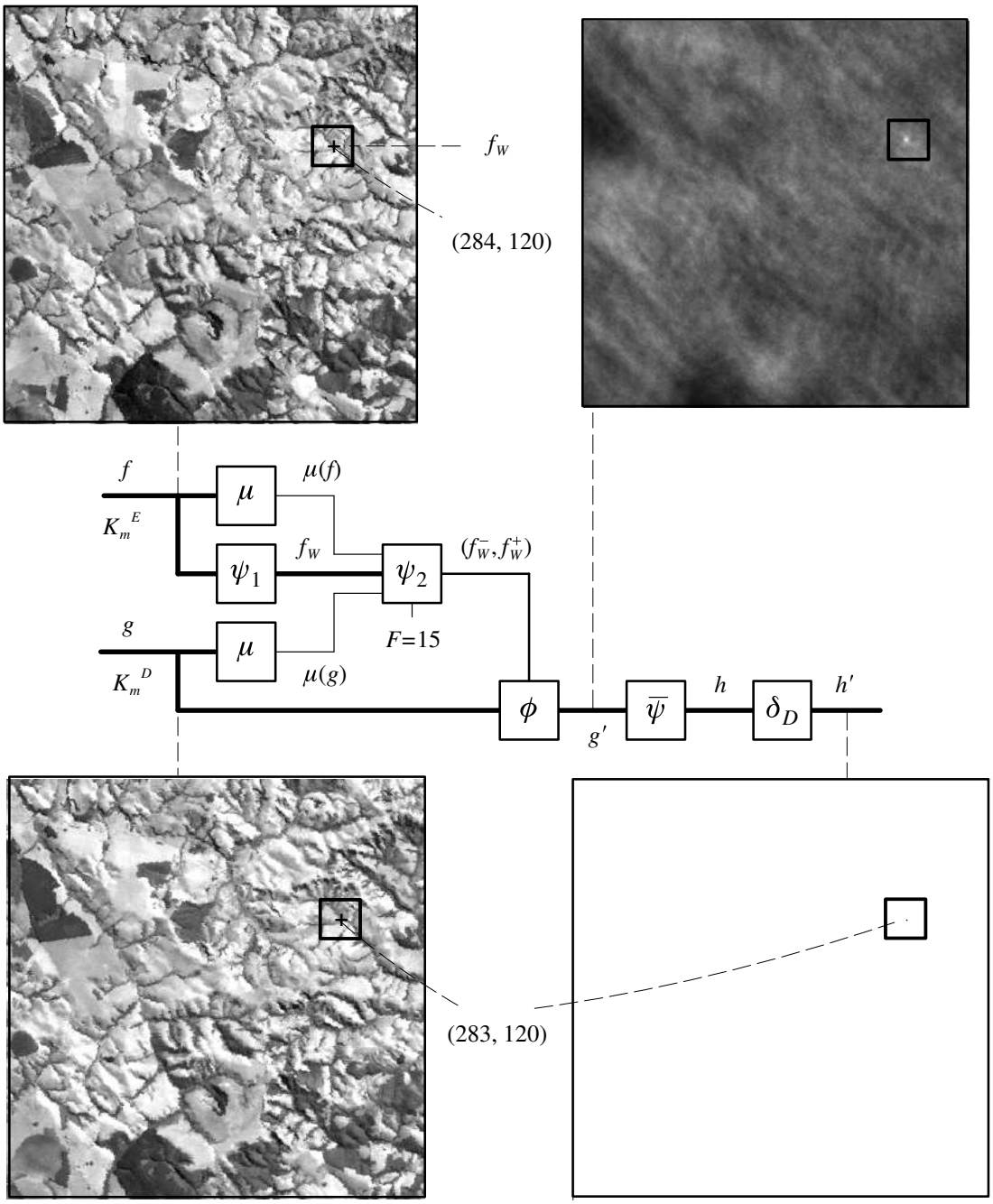
TM/LANDSAT image



EXPERIMENTAL RESULT

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$$n = 51 \times 51 = 2601$$

Parameters of the Experiment		Result of the Algorithm		Visual Location
Template Center in the Reference Image f (col., row)	F	Maximum value in $g'(G)$	Position of the Maximum Value (col., row)	Template Location in the Search Image g (col., row)
(241,37)	15	580	(240,37)	(240,37)
	30	1151	(240,37)	
	45	1528	(240,37)	
(284,120)	15	571	(283,120)	(283,120)
	30	1057	(283,120)	
	45	1440	(283,120)	
(37,243)	15	657	(37,243)	(37,242)
	30	1250	(36,242)	
	45	1648	(36,242)	

REFERENCES

(1/1)

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