Coarse-to-Fine Flow Estimation

Shree K. Nayar

Columbia University

Topic: Motion and Optical Flow, Module: Reconstruction II

First Principles of Computer Vision

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What if we have Large Motion?

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What if we have Large Motion?

Taylor Series approximation of

$I(x + \delta x, y + \delta y, t + \delta t)$ is not valid

Our simple linear
constraint equation not valid

$$I_x u + I_y v + I_t \neq 0$$

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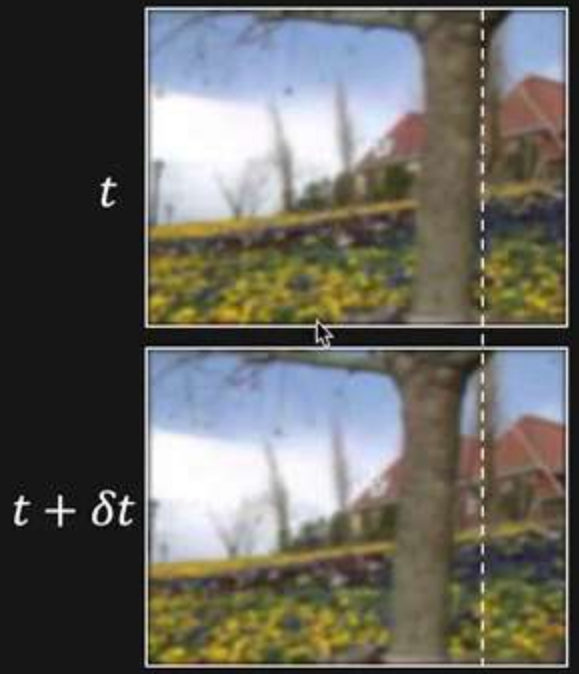
Large Motion: Coarse-to-Fine Estimation



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Large Motion: Coarse-to-Fine Estimation

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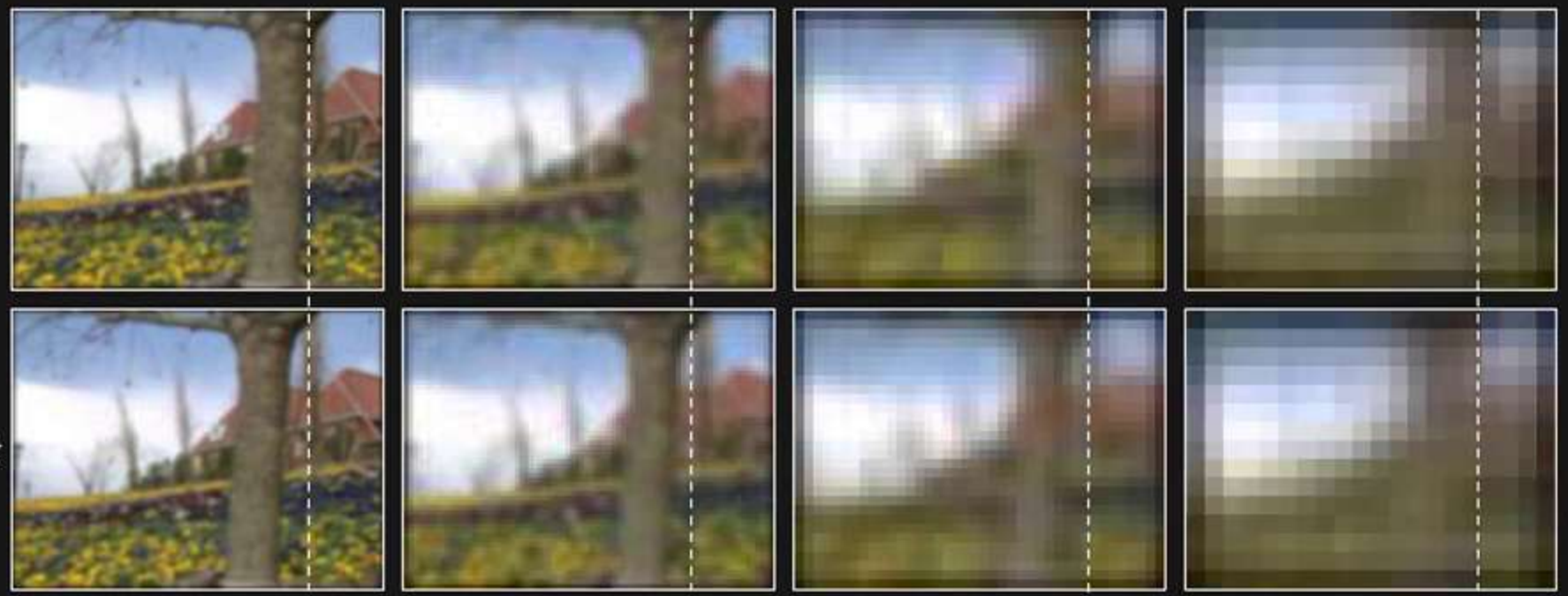

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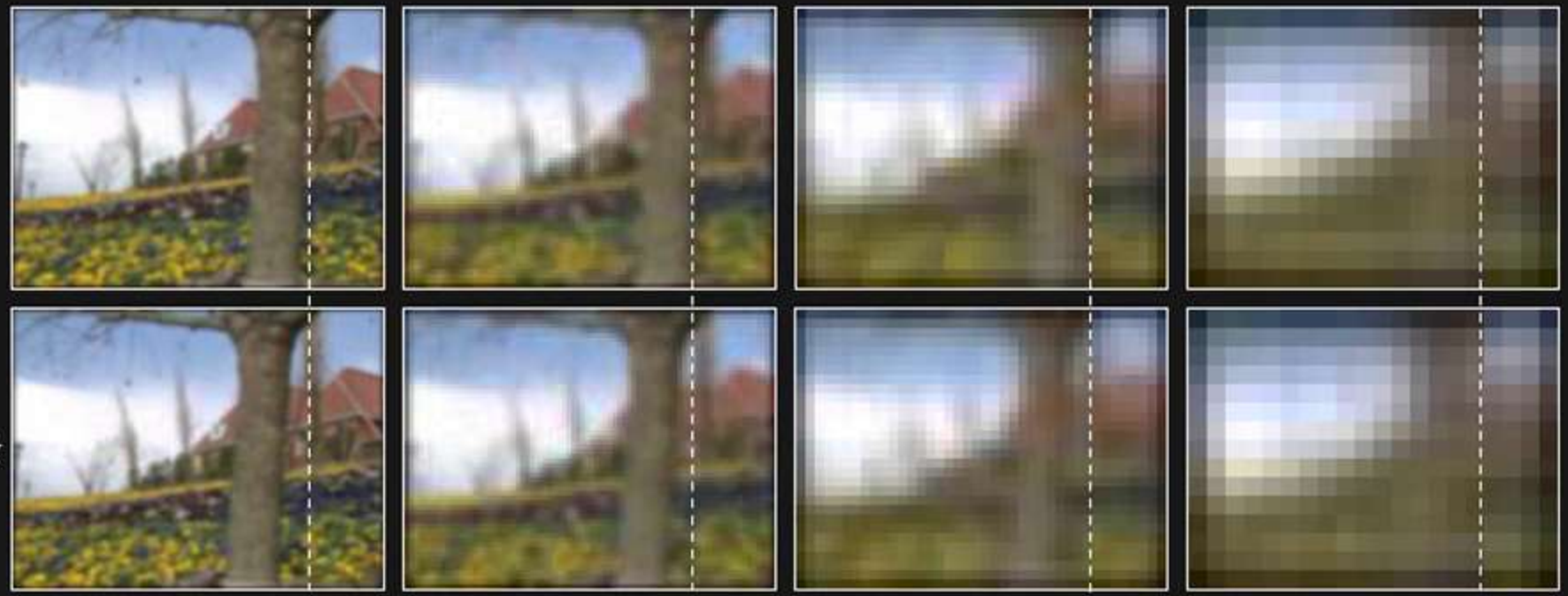

At lowest resolution, motion ≤ 1 pixel

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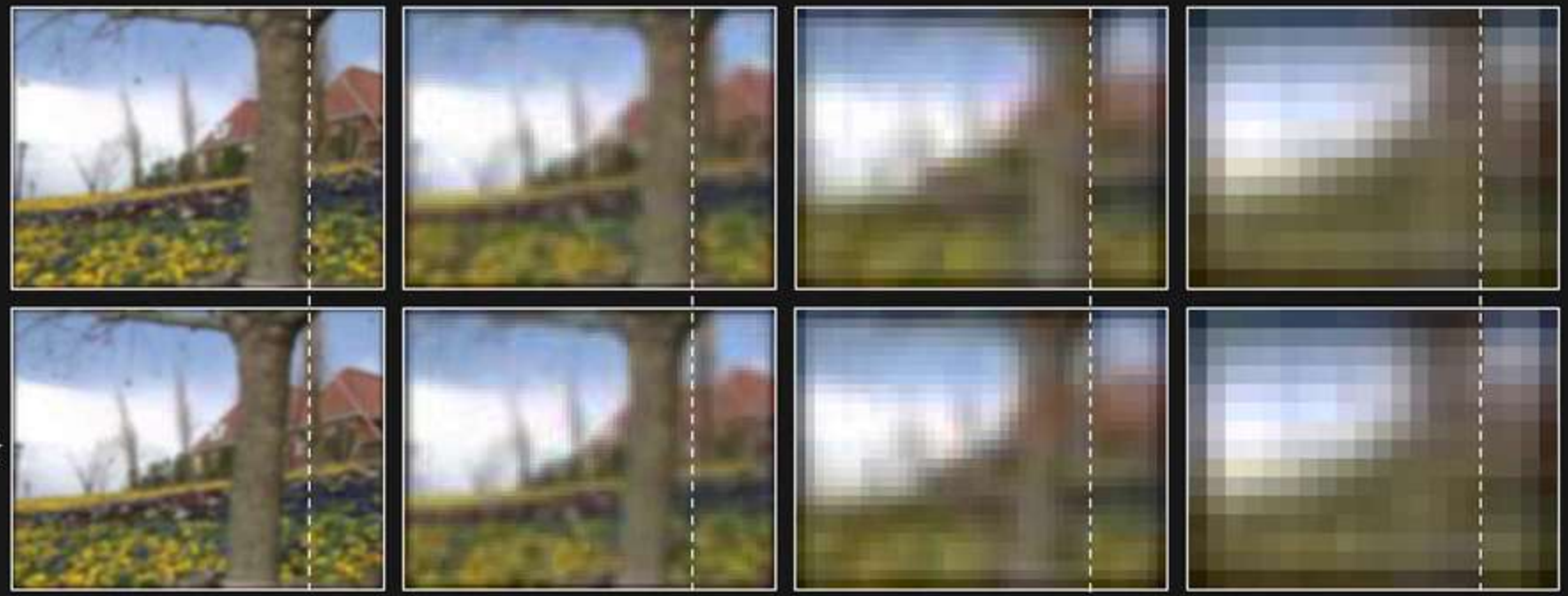

At lowest resolution, motion ≤ 1 pixel

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Coarse-to-Fine Estimation Algorithm

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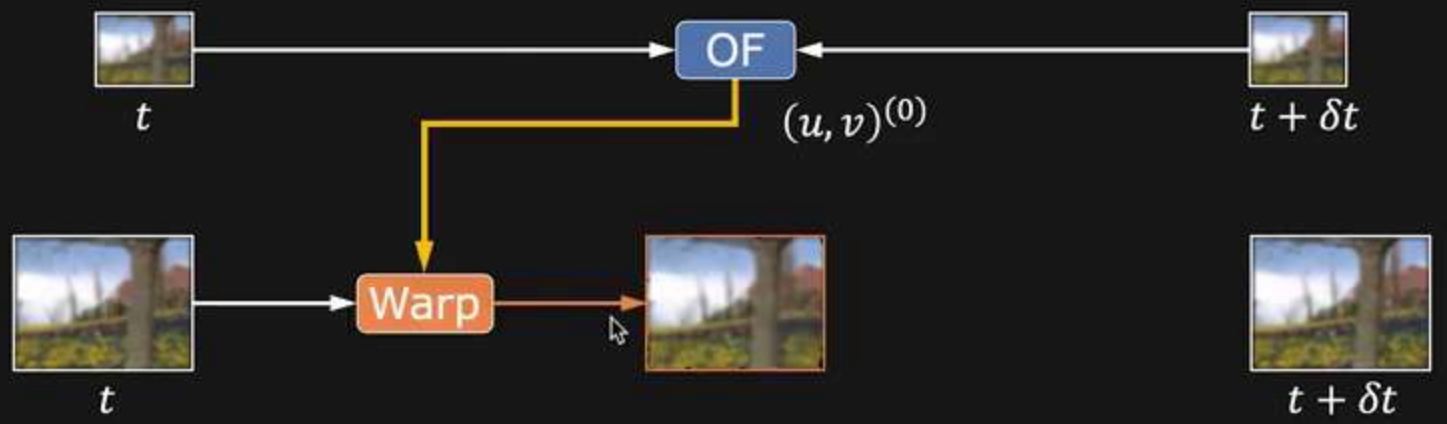

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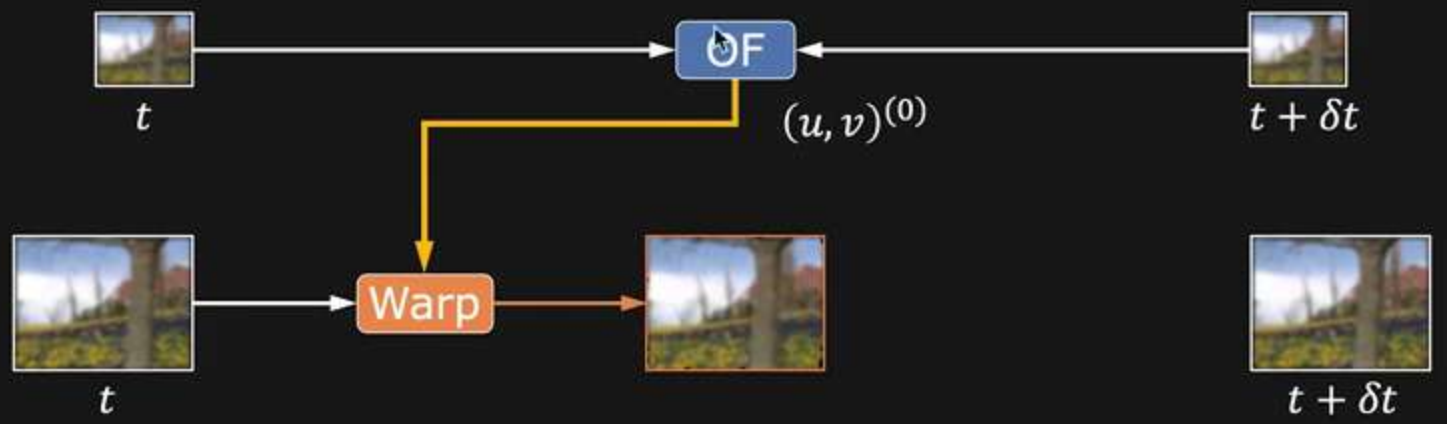

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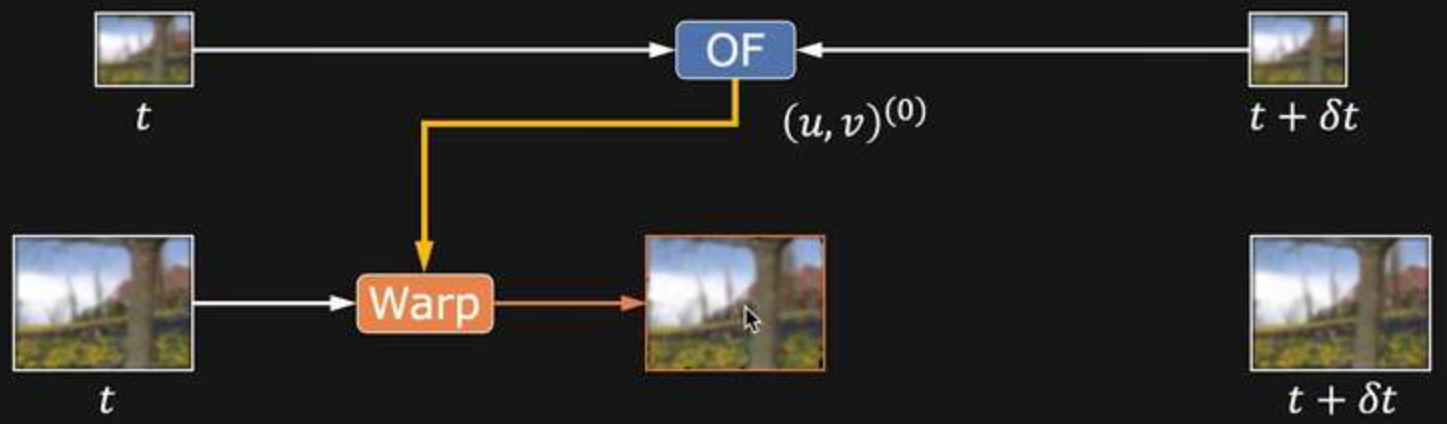

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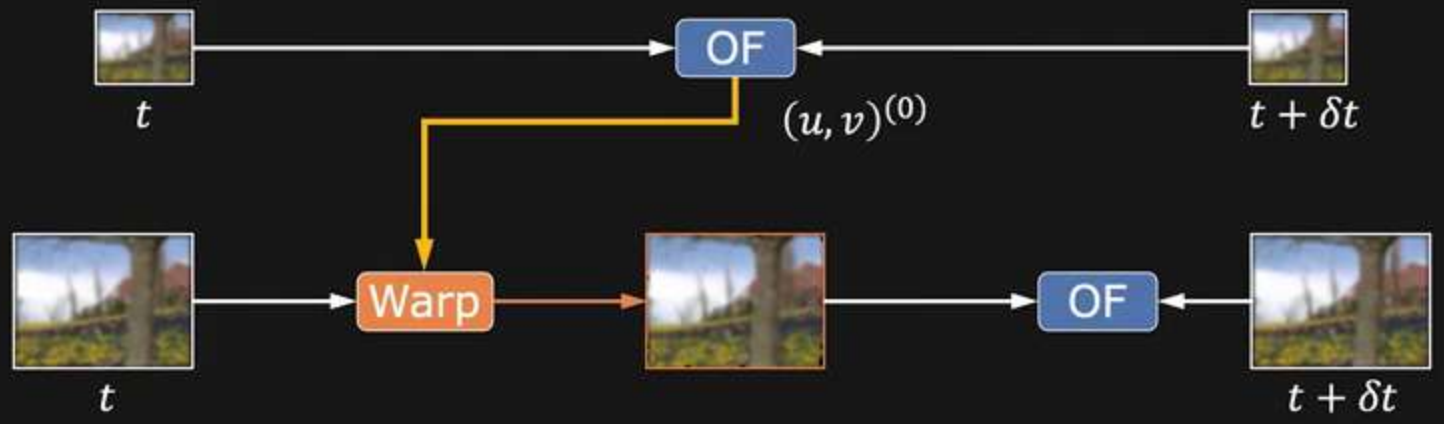

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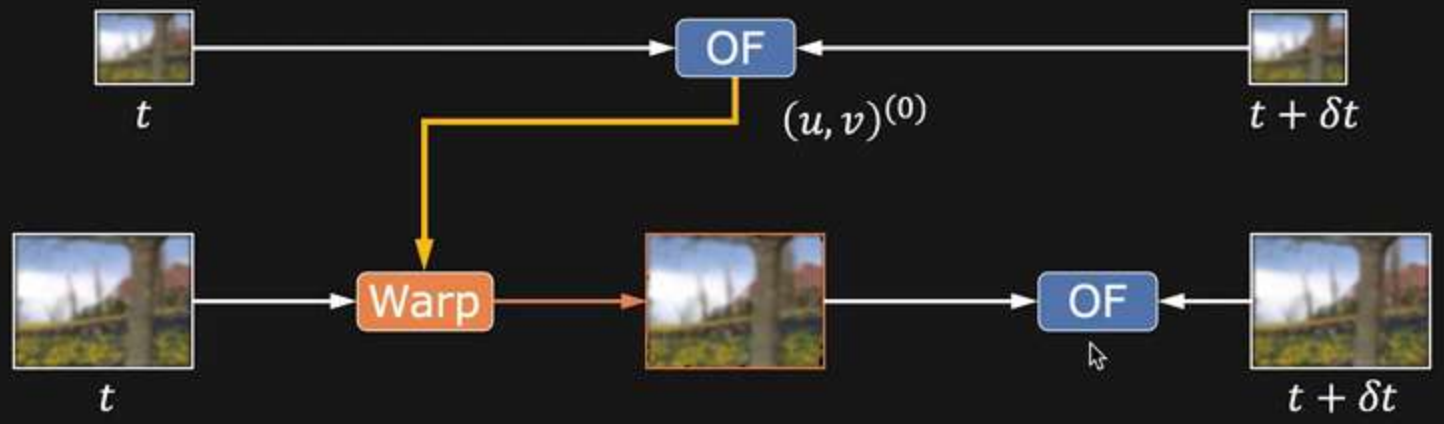

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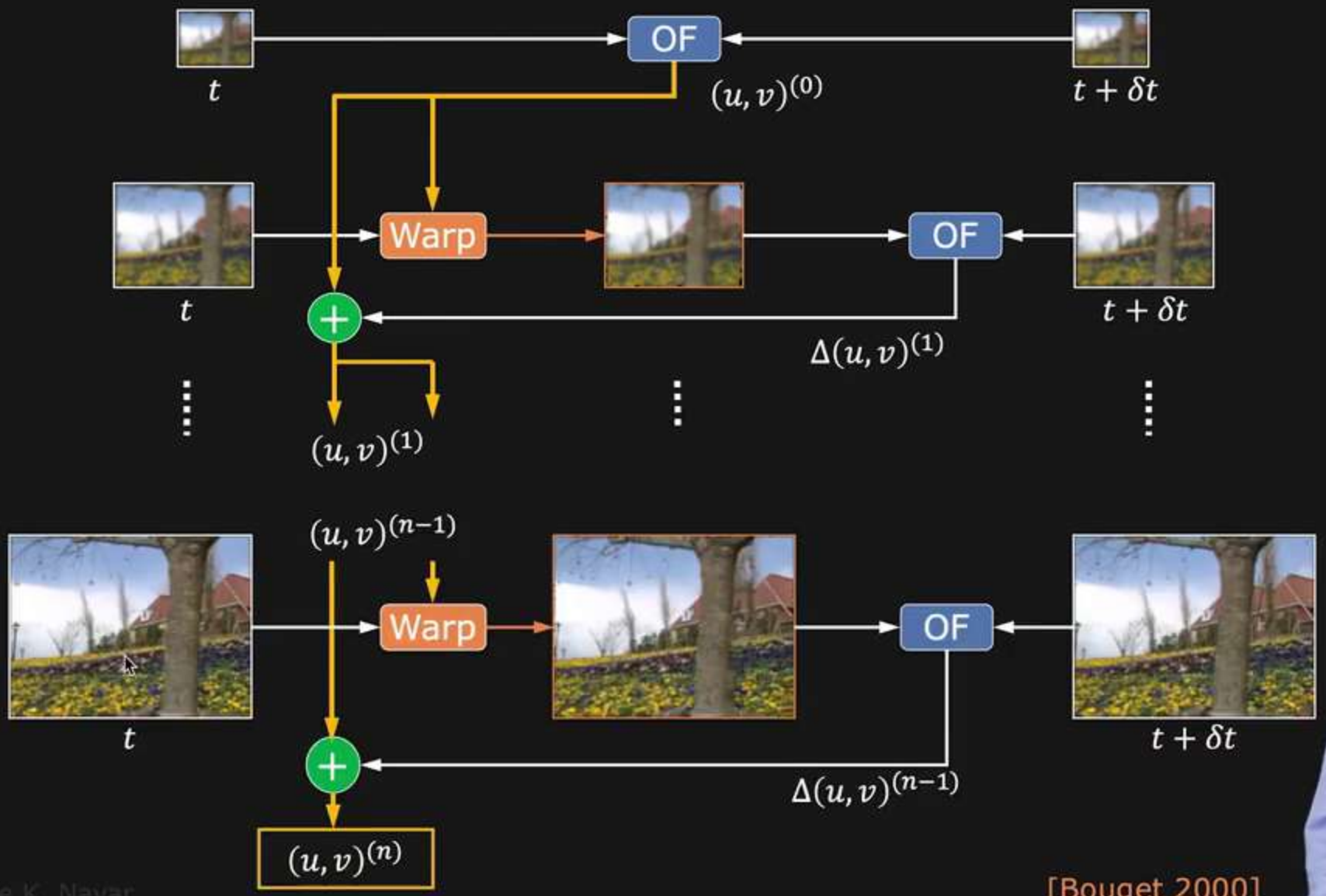

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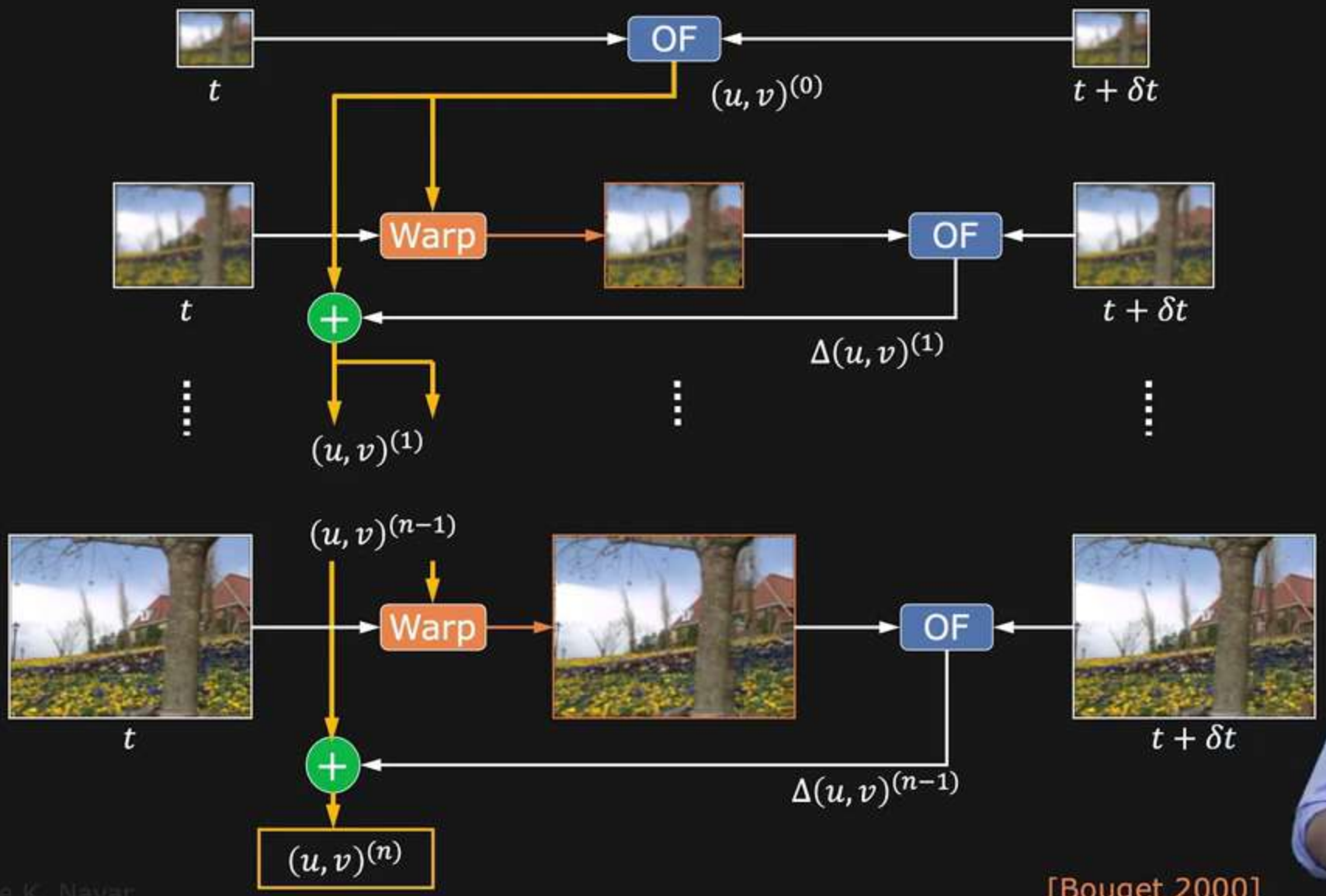

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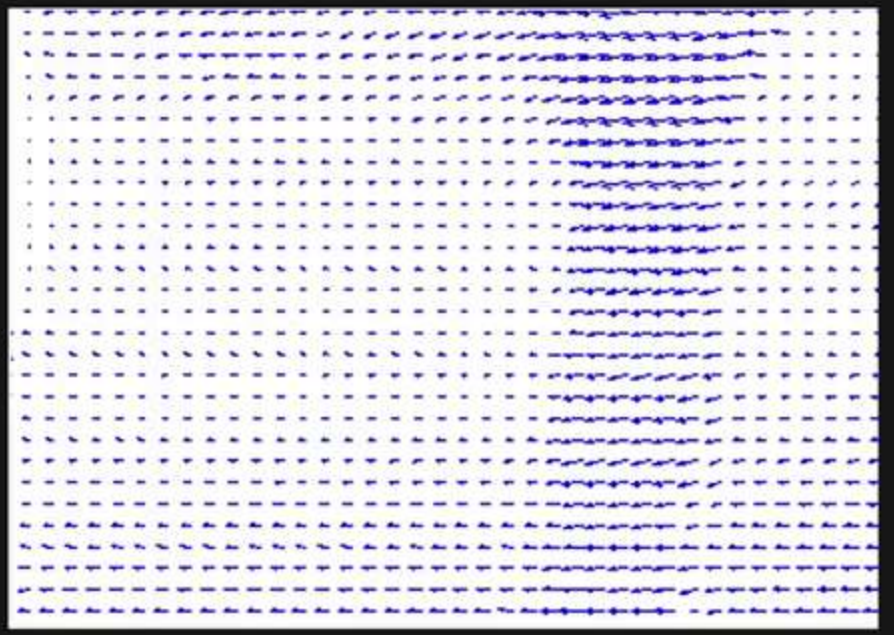
Results: Tree Sequence

Image Sequence



Optical Flow

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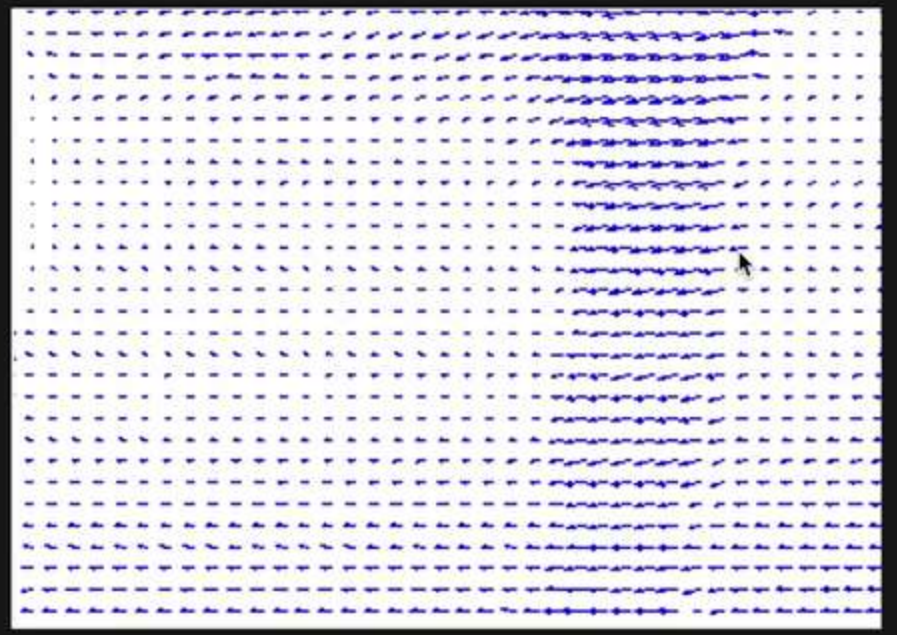

Optical Flow

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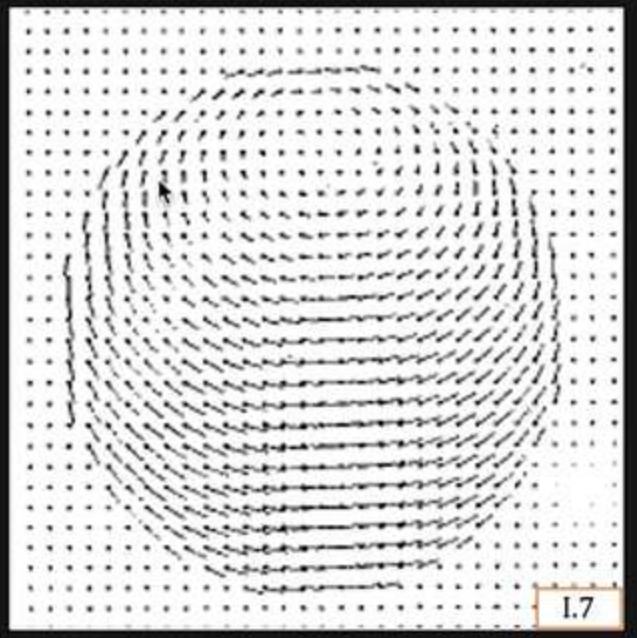
Results: Rotating Ball

Image Sequence



Optical Flow

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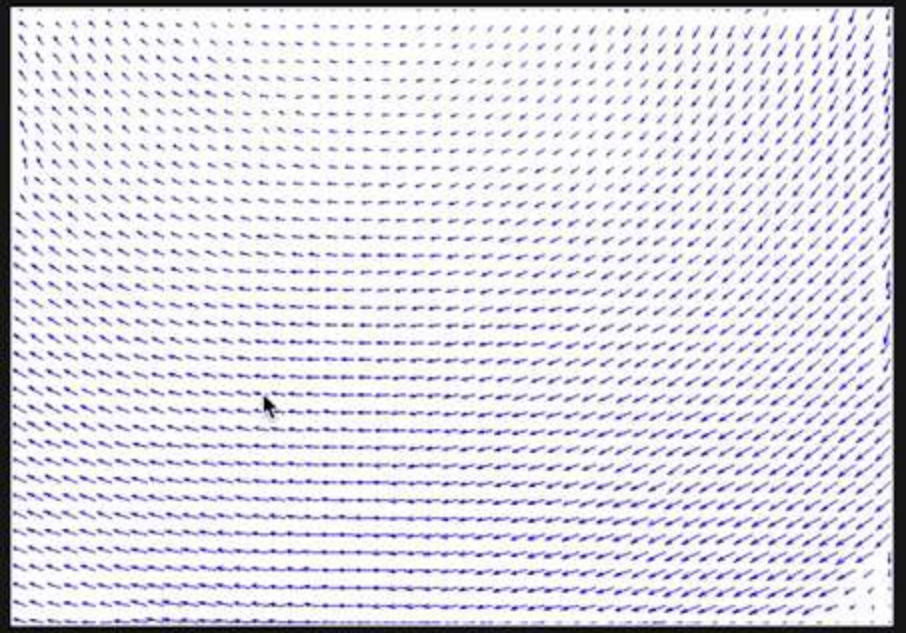
Results: Rotating Camera

Image Sequence



Optical Flow

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Alternative Approach: Template Matching

Determine Flow using Template Matching

Image I_1 at time t

Image I_2 at time $t + \delta t$

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Alternative Approach: Template Matching

Determine Flow using Template Matching

Template Window T

Image I_1 at time t

Image I_2 at time $t + \delta t$

For each template window T in image I_1,

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Alternative Approach: Template Matching

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Search Window S

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Large Motion: Template matching

Determine Flow using Template Matching

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Template matching is slow
when search window S is large.
Also, mismatches are possible.

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