Spatiotemporal Video Amplification

6.111 Final Project Presentation

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See the Invisible

Color Amplification

Motivation

- Improvements in camera technology have enabled capturing of small changes

- These changes are often invisible to the naked eye

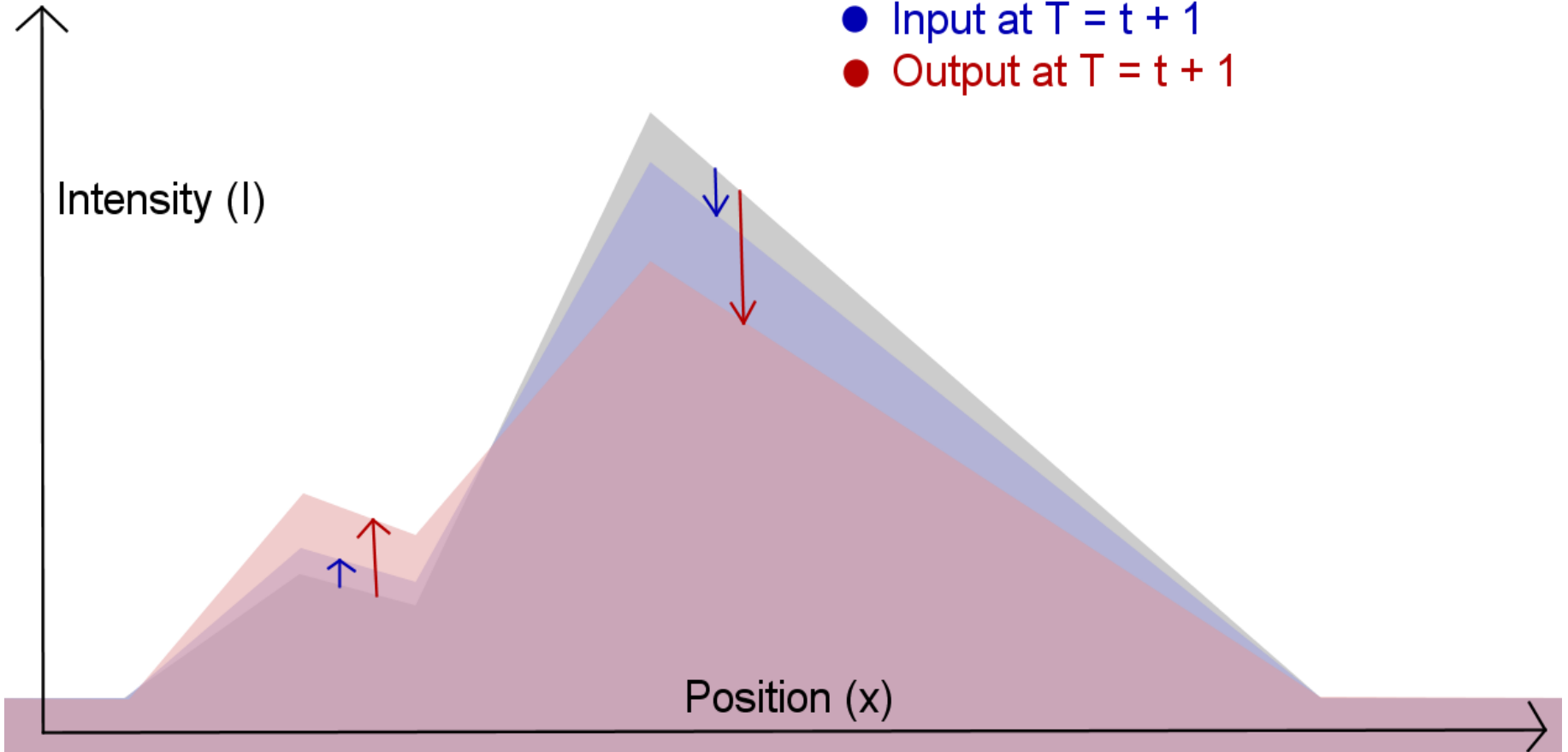- Real time video processing is computation intensive

Applications

- Biomedical Imaging

- Medical Monitoring Systems

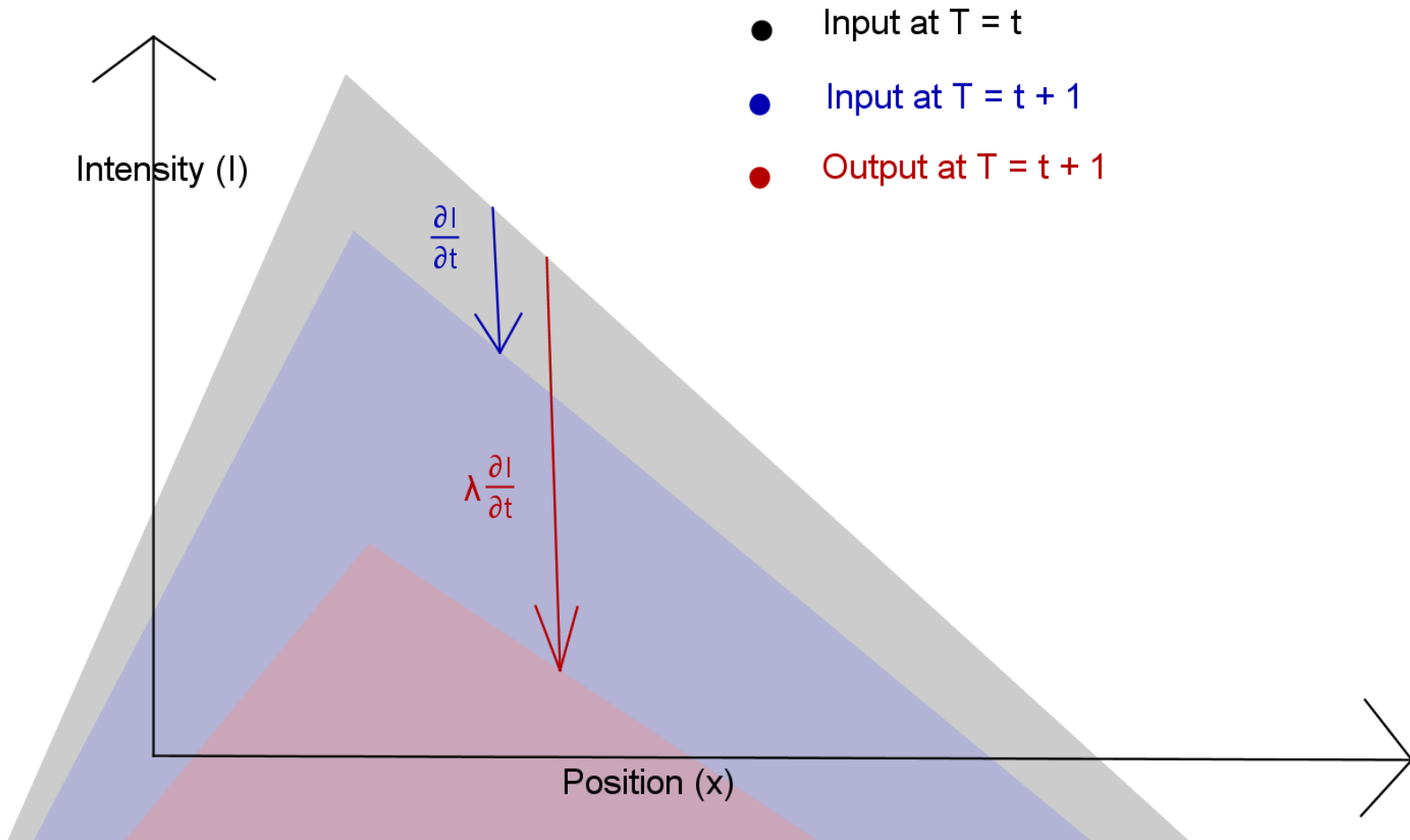- Physics and Chemistry Research

- Surveillance
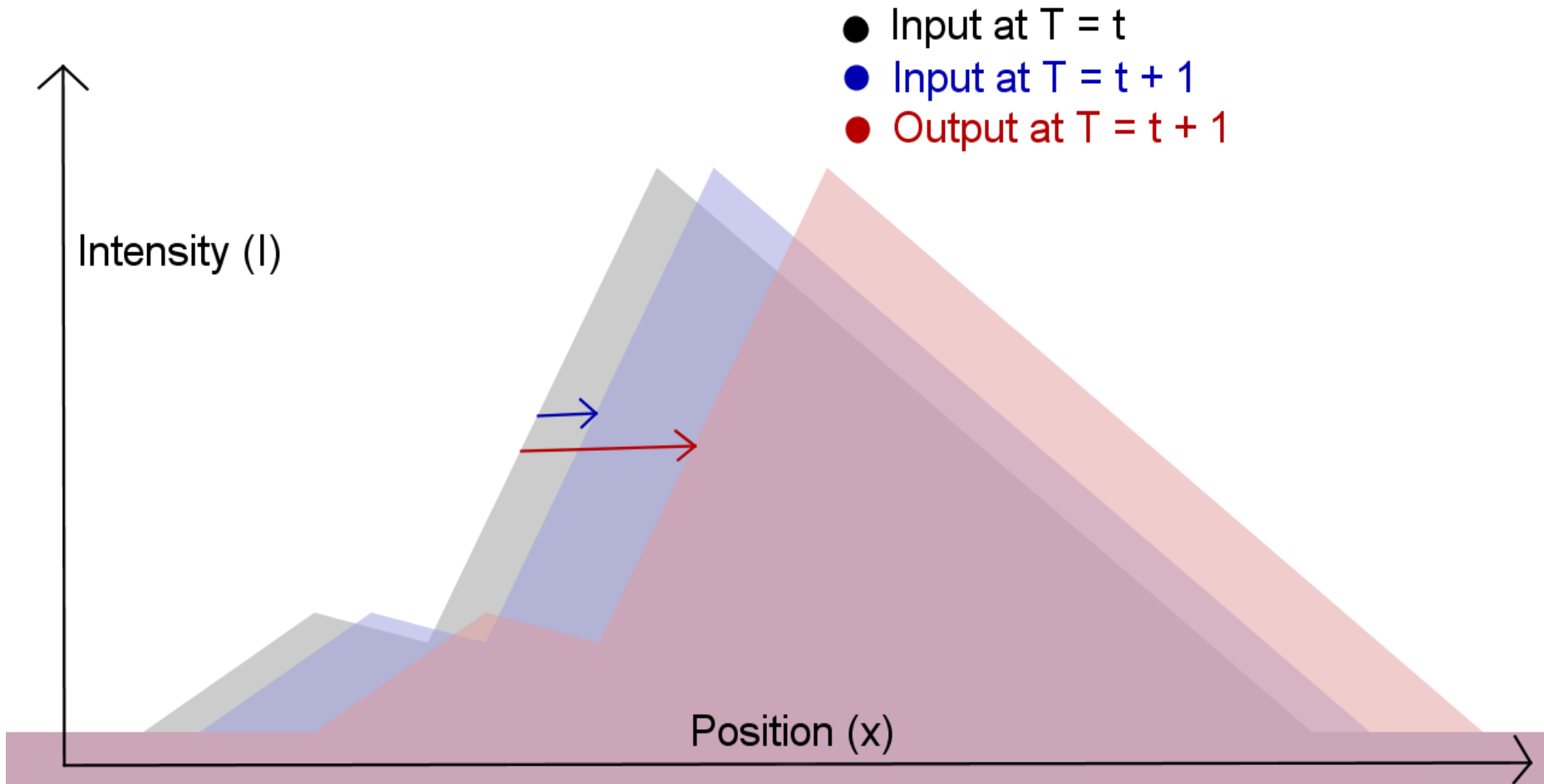
- Sports

Theory: Temporal Amplification

● Input at T = t
● Input at T = t + 1
● Output at T = t + 1

Intensity (I)

Position (x)

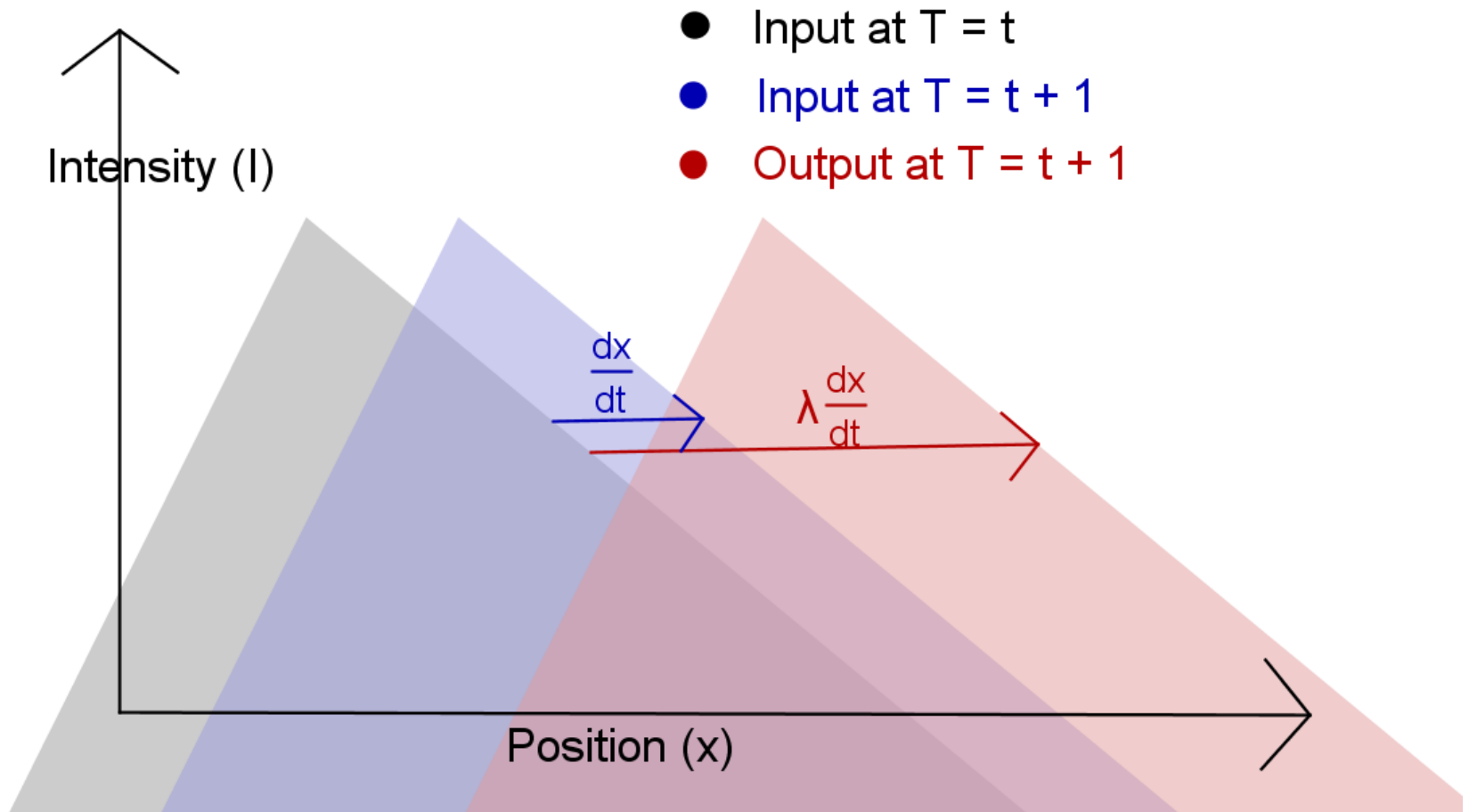**Massachusetts Institute of Technology**

Theory: Temporal Amplification

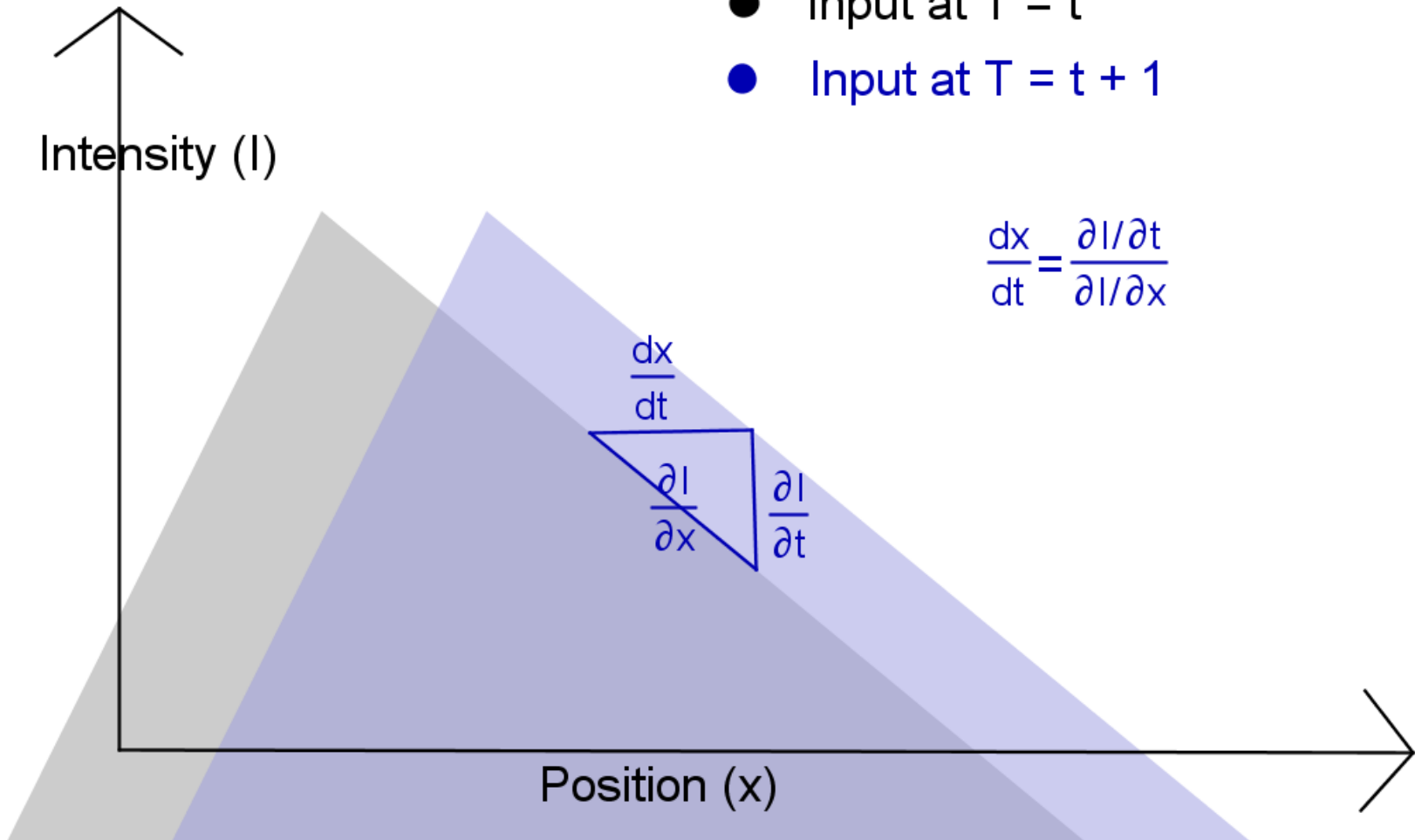# Theory: Spatial Amplification

Theory: Spatial Amplification

Theory: Spatial Amplification

- ● Input at T = t
- ● Input at T = t + 1

$$\frac{dx}{dt} = \frac{\partial I/\partial t}{\partial I/\partial x}$$

Intensity (I)

$\frac{dx}{dt}$

$\frac{\partial I}{\partial x}$ $\frac{\partial I}{\partial t}$
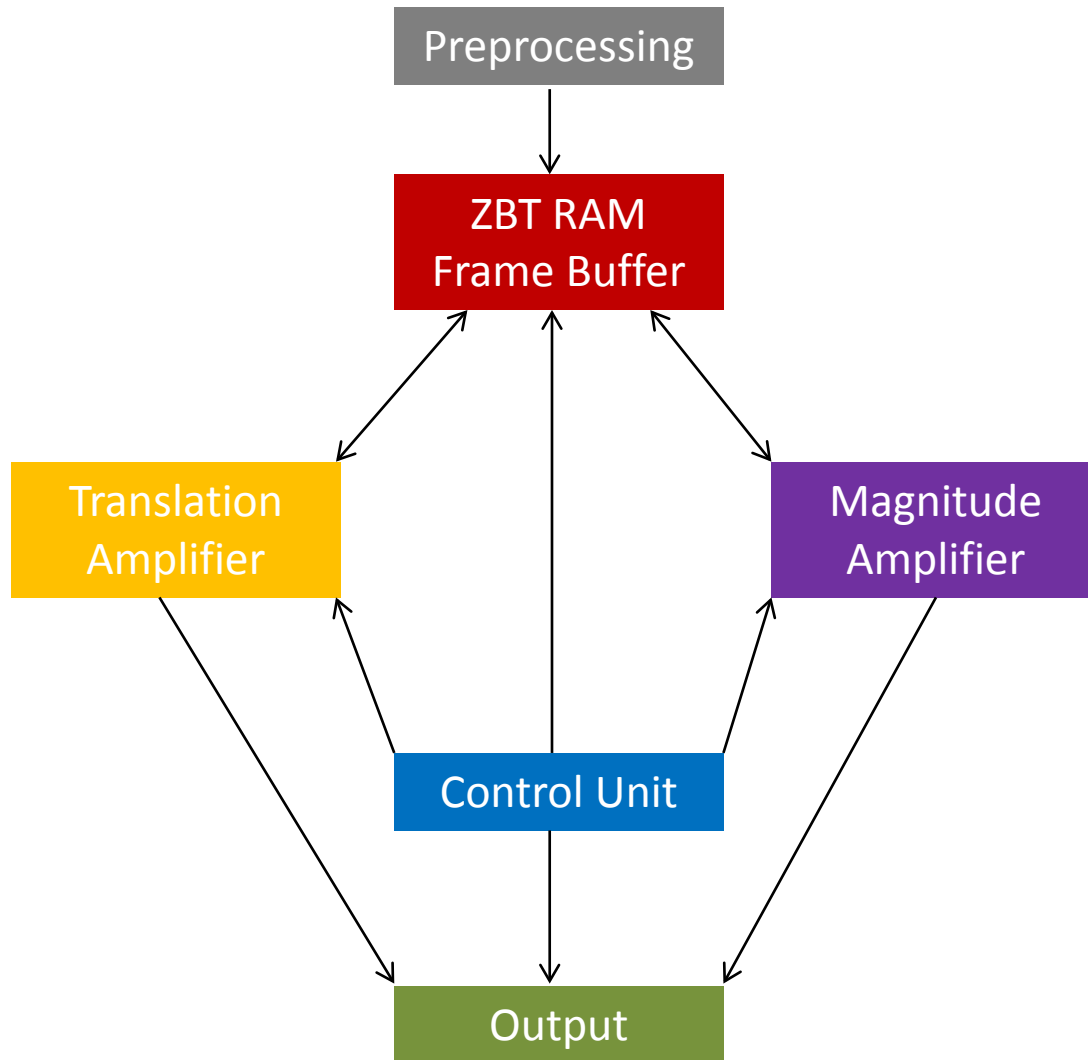
Position (x)

Theory: equations

$$J(x, y, t) =$$

$$I\left(x + \lambda\frac{\partial I/\partial t}{\partial I/\partial x}, y + \lambda\frac{\partial I/\partial t}{\partial I/\partial y}, t\right) + \mu\frac{\partial I}{\partial t} \qquad (1)$$

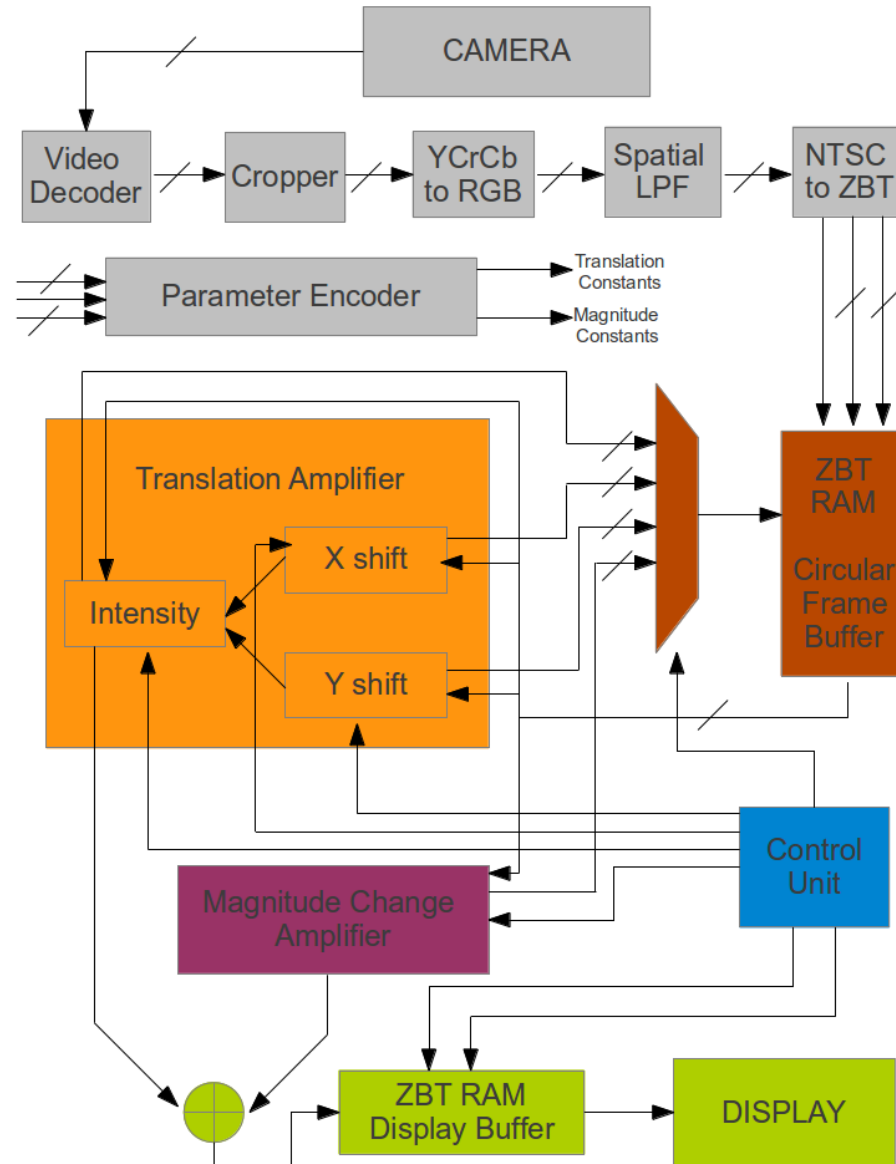$$J(x, y) = I(x + \lambda\frac{I(x, y, t) - I(x, y, t - k)}{I(x, y, t) - I(x - k, y, t)},$$

$$y + \lambda\frac{I(x, y, t) - I(x, y, t - k)}{I(x, y, t) - I(x, y - k, t)}, t)$$

$$+\mu\frac{I(x, y, t) - I(x, y, t - k)}{k} \qquad (2)$$
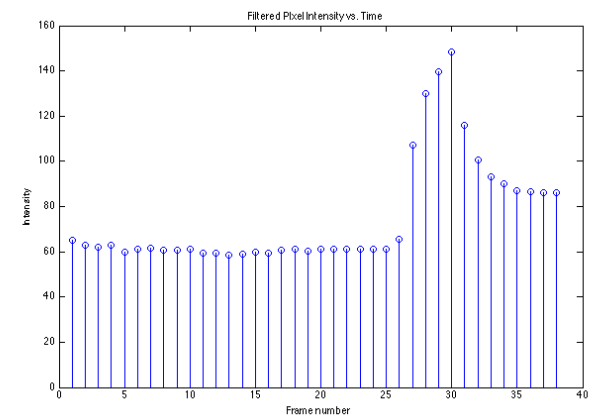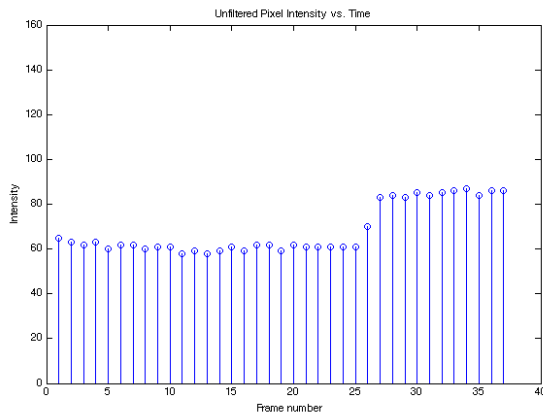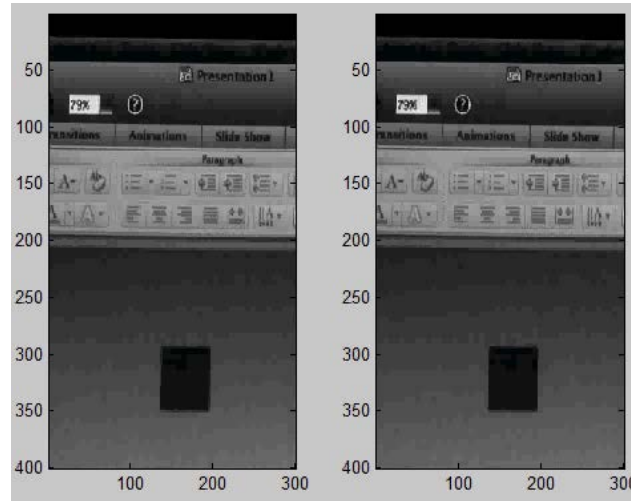
System Design

Hardware Implementation
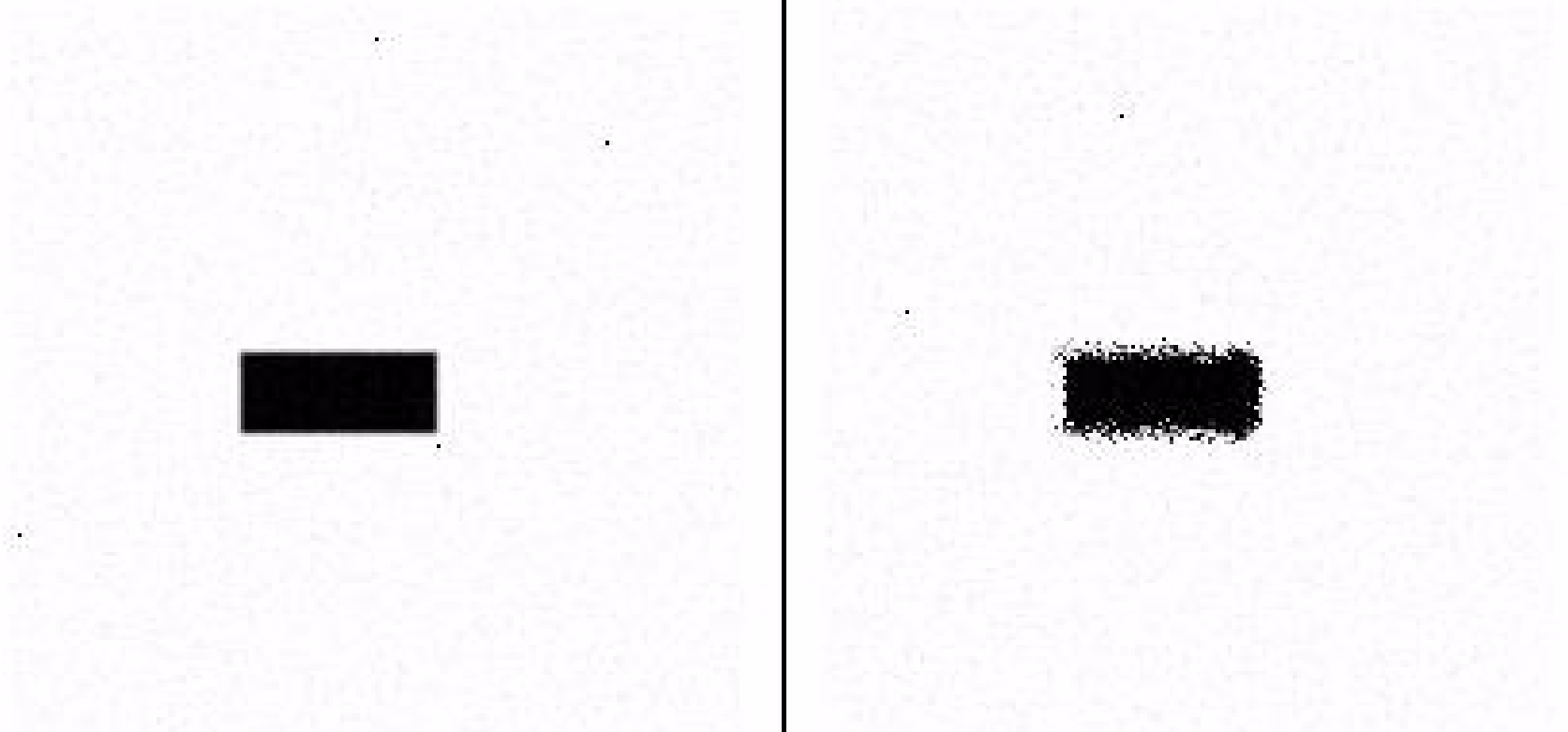
Software Prototyping
Temporal Amplification

Software Prototyping
Spatial Amplification

Software Prototyping
Handling Noise

Timeline

- Week of Nov 12th –
  - ZBT RAM and preprocessing modules will be implemented.
- Nov 19th –
  - Demonstrate temporal amplification on grayscale images
- Nov 29th –
  - Demonstrate spatial amplification on grayscale images.

The remaining time will be used for testing and debugging. If time permits we will modify our design for full color operation and/or frequency selective capabilities.