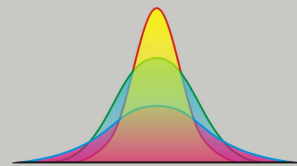# 大话成像之

数字成像系统 32讲

自动对焦

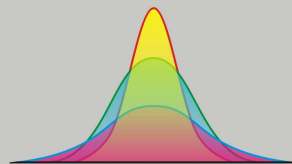Maver Jiang

imaging algorithm specialist

staff image quality engineer
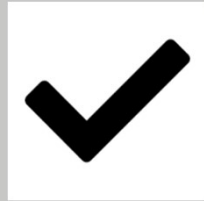
maver.jiang@gmail.com

This training includes:

- Autofocus system overview
- Actuator driver
- AF filter and statistics
- AF zones and ROI configuration
- Single Autofocus Algorithm
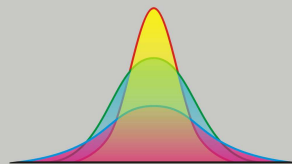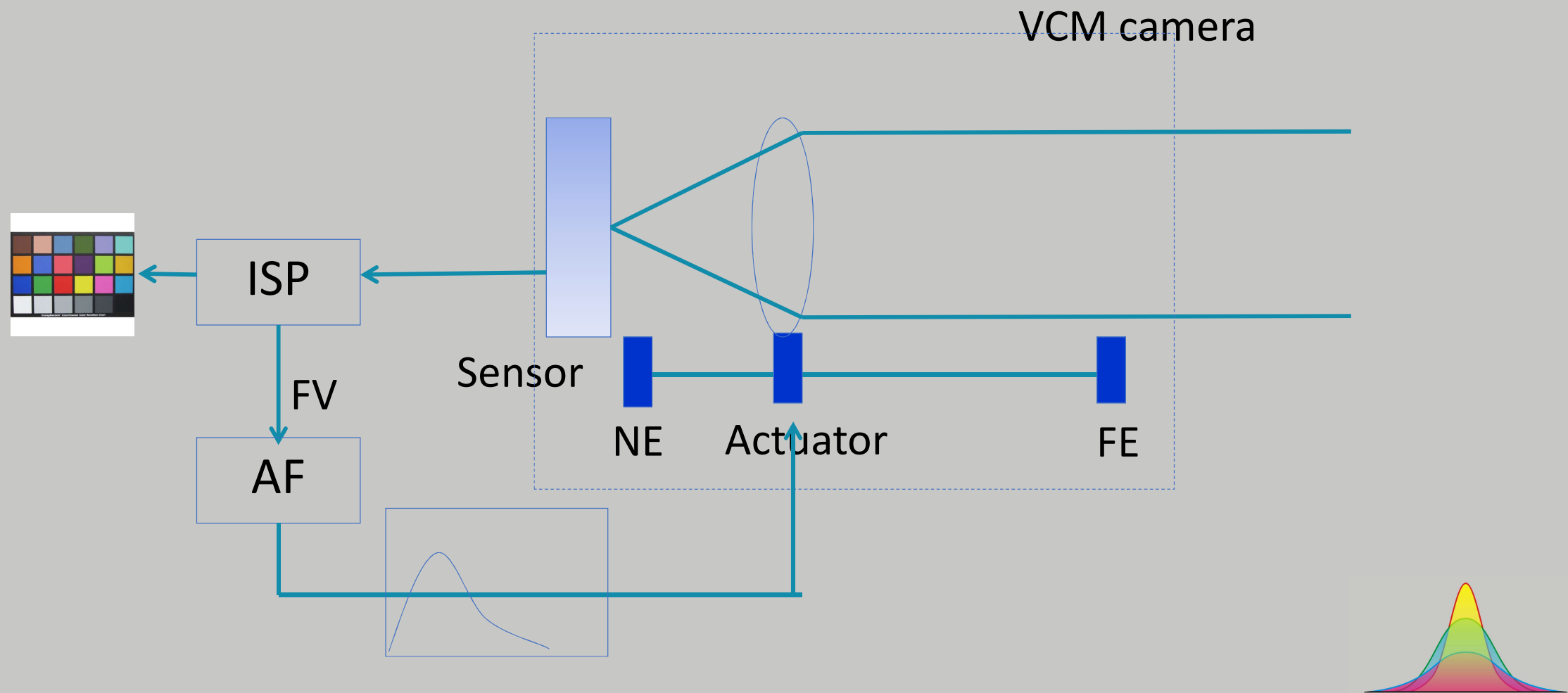- Continuous Autofocus Algorithm

Autofocus system overview
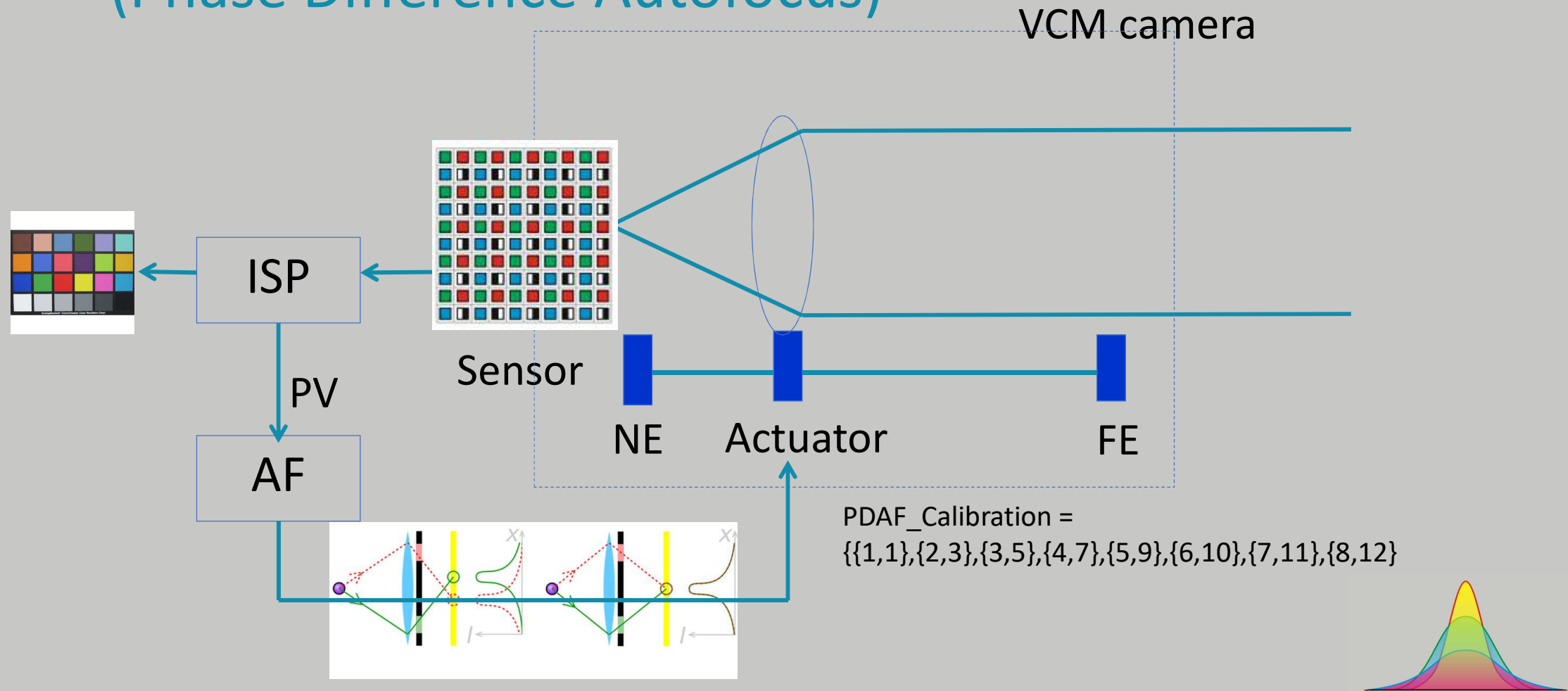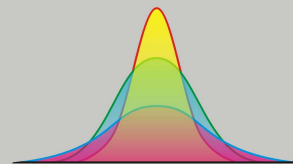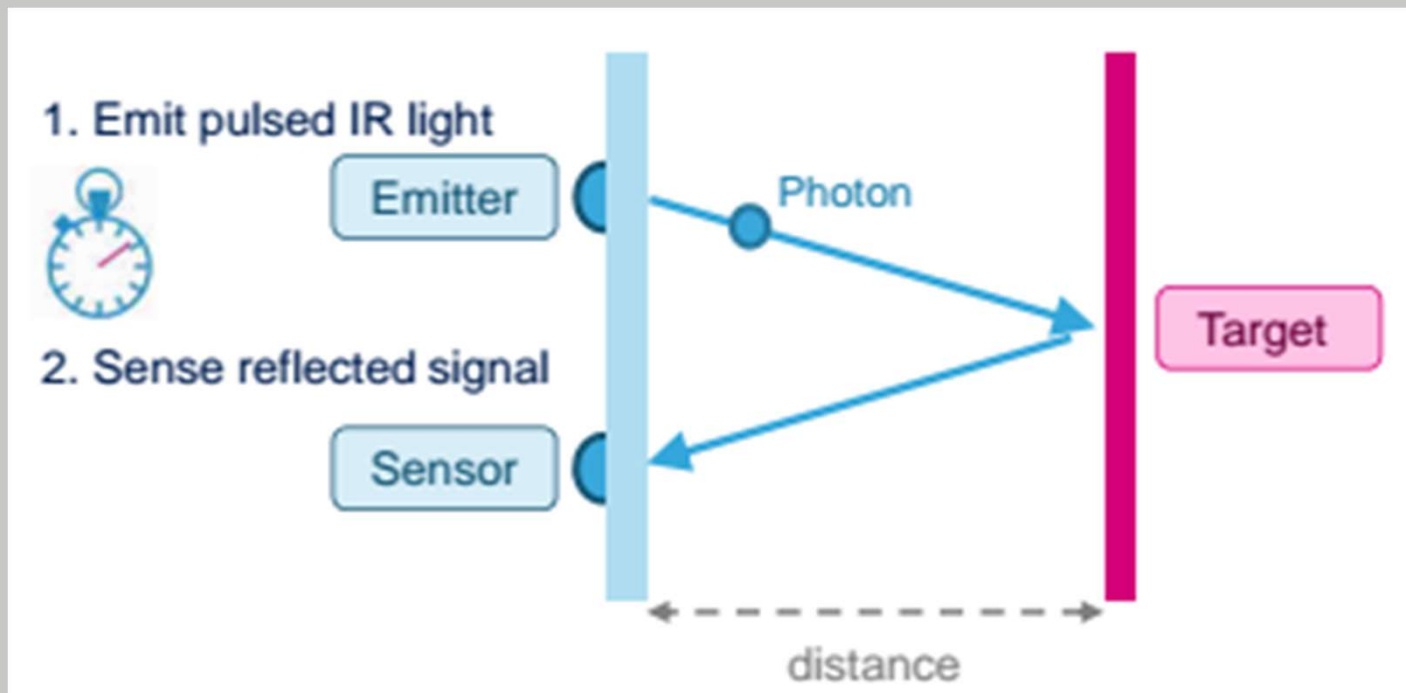
- CDAF ✔

- PDAF

- Laser assisted AF

CDAF

VCM camera

ISP

Sensor

NE

Actuator

FE

FV

AF

PDAF

(Phase Difference Autofocus)

VCM camera

ISP

PV

AF

Sensor

NE

Actuator

FE

PDAF_Calibration =
{{1,1},{2,3},{3,5},{4,7},{5,9},{6,10},{7,11},{8,12}}

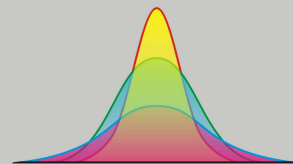# Laser AF

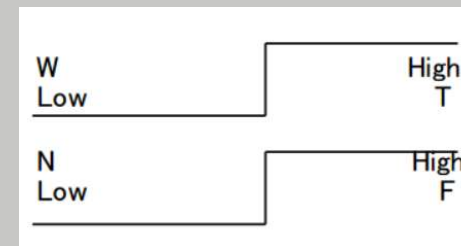## TOF(time of flight) Sensor

VCM / Step Motor Driver

VCM:
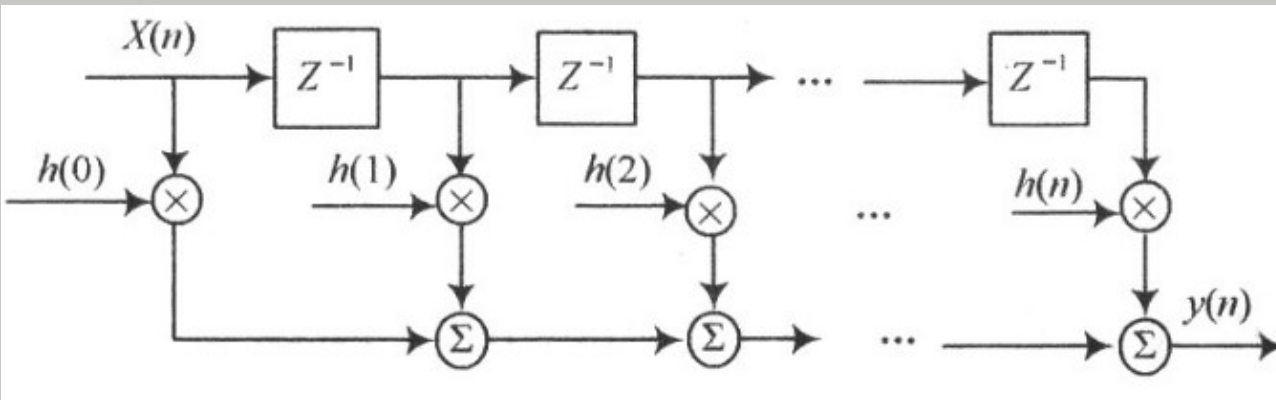- Ringing effect
- Border control
- Step size control

Stepper motor

CDAF filters and Statistics

FIR filter

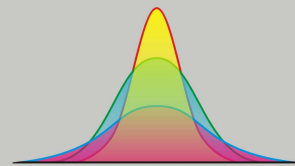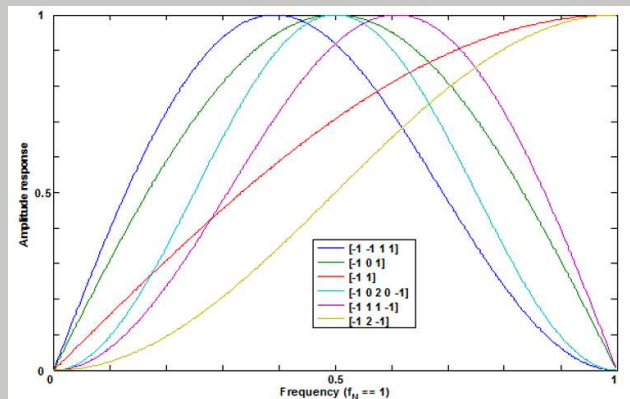$$y[n] = \sum_{k=0}^{n} h(k)x(n-k)$$

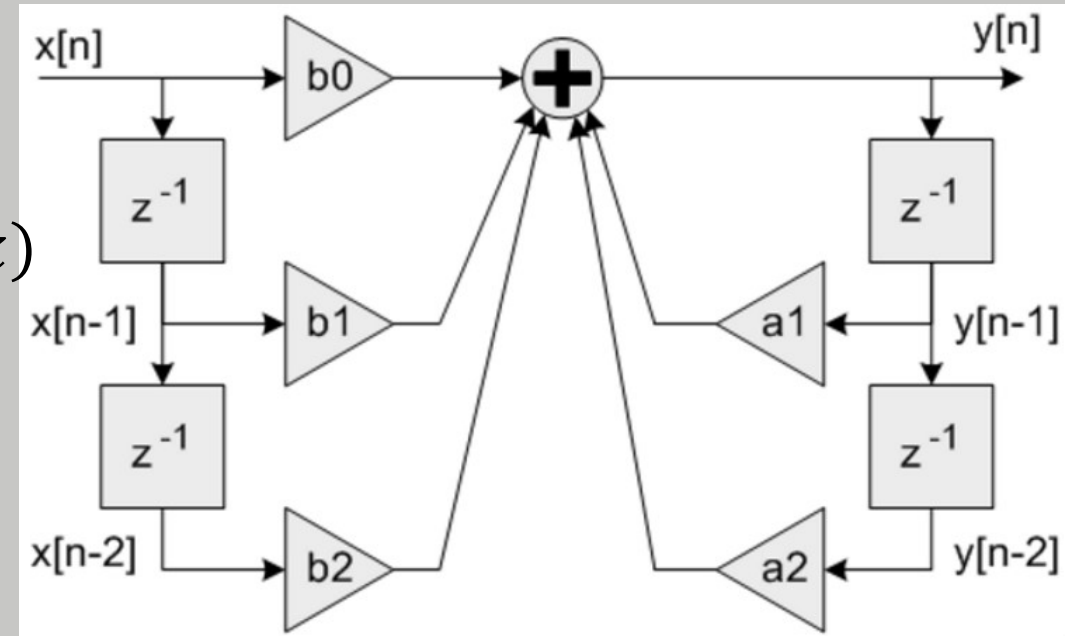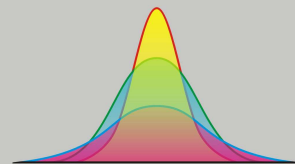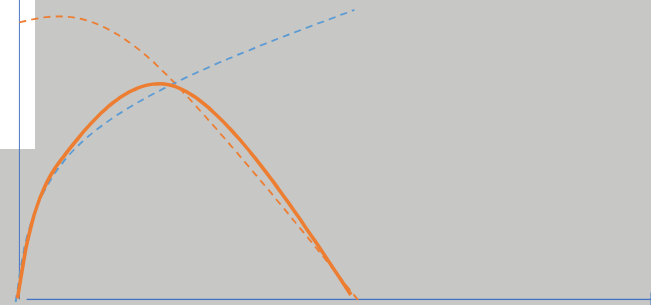| Operator	3×3			5×5				
Laplacian	$\begin{bmatrix} -1 & -1 & -1 \\ -1 & +8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$			$\begin{bmatrix} -1 & -3 & -4 & -3 & -1 \\ -3 & 0 & +6 & 0 & -3 \\ -4 & +6 & +20 & +6 & -4 \\ -3 & 0 & +6 & 0 & -3 \\ -1 & -3 & -4 & -3 & -1 \end{bmatrix}$				
Horizontal Sobel	$\begin{bmatrix} +1 & +2 & +1 \\ -2 & -4 & -2 \\ +1 & +2 & +1 \end{bmatrix}$			$\begin{bmatrix} +1 & +4 & +6 & +4 & +1 \\ 0 & 0 & 0 & 0 & 0 \\ -2 & -8 & -12 & -8 & -2 \\ 0 & 0 & 0 & 0 & 0 \\ +1 & +4 & +6 & +4 & +1 \end{bmatrix}$				
Vertical Sobel	$\begin{bmatrix} +1 & -2 & +1 \\ +2 & -4 & +2 \\ +1 & -2 & +1 \end{bmatrix}$			$\begin{bmatrix} +1 & 0 & -2 & 0 & +1 \\ +4 & 0 & -8 & 0 & +4 \\ +6 & 0 & -12 & 0 & +6 \\ +4 & 0 & -8 & 0 & +4 \\ +1 & 0 & -2 & 0 & +1 \end{bmatrix}$				
Cross Sobel	$\begin{bmatrix} -1 & 0 & +1 \\ 0 & 0 & 0 \\ +1 & 0 & -1 \end{bmatrix}$			$\begin{bmatrix} -1 & -2 & 0 & +2 & +1 \\ -2 & -4 & 0 & +4 & +2 \\ 0 & 0 & 0 & 0 & 0 \\ +2 & +4 & 0 & -4 & -2 \\ +1 & +2 & 0 & -2 & -1 \end{bmatrix}$				

https://en.wikipedia.org/wiki/Finite_impulse_response

CDAF filters and Statistics

IIR filter

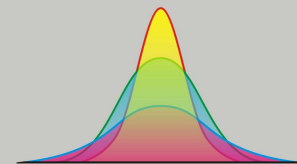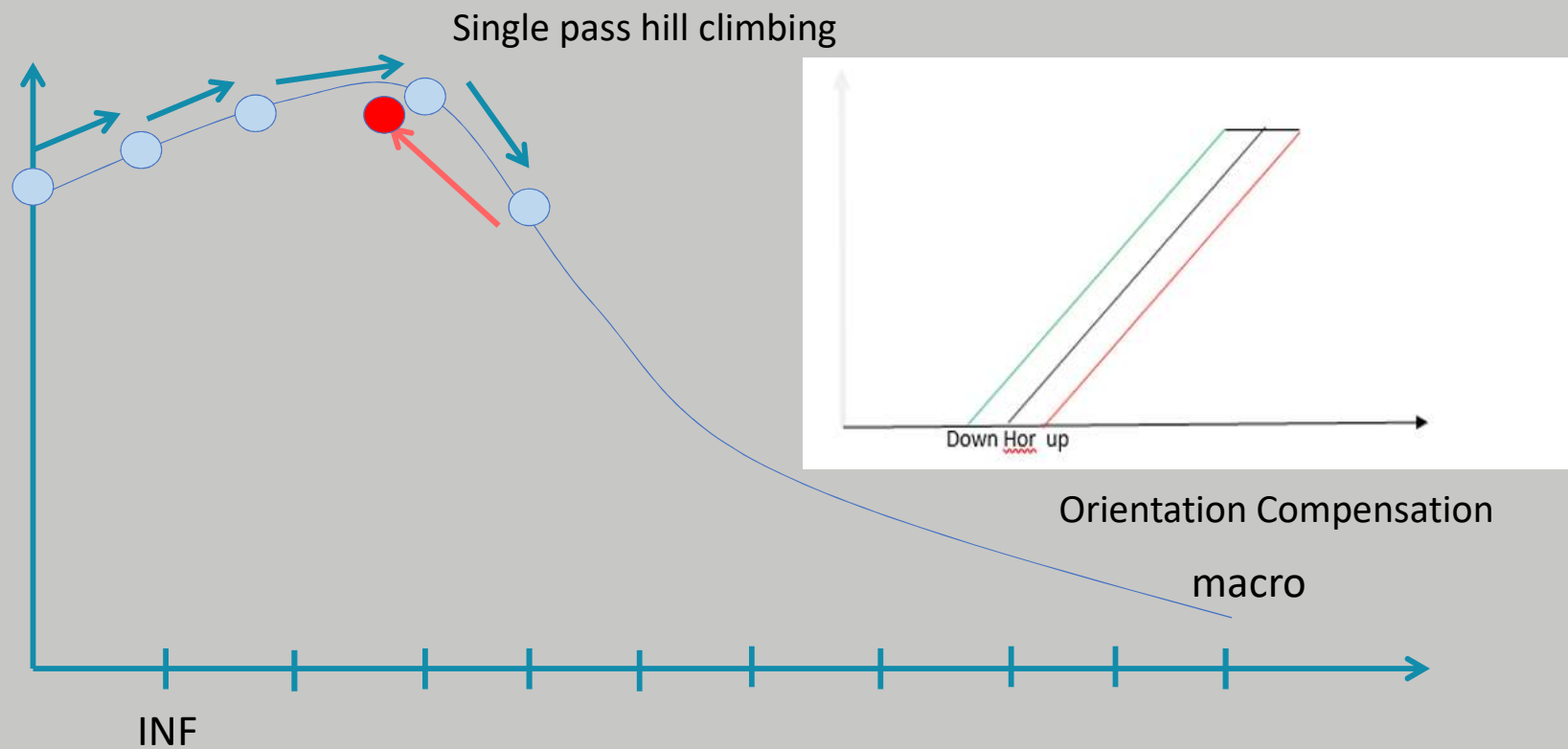$$y[n] = \sum_{k=0}^{m} b_k x(n-k) - \sum_{k=1}^{N} a_k y(n-k)$$

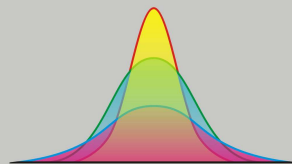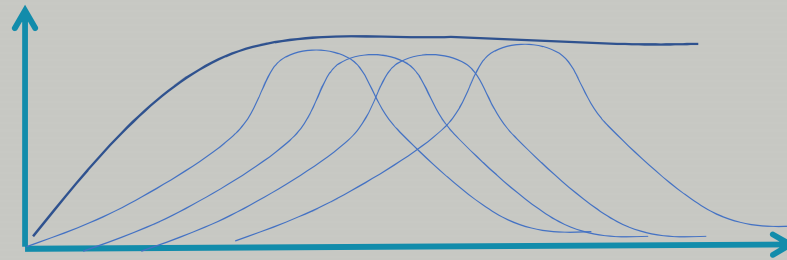c = [8, -95, -49, 38, 76, 38, -111, -54, 17, -34, 17];

https://en.wikipedia.org/wiki/Infinite_impulse_response

Single AF Algorithm

Single pass hill climbing

Orientation Compensation

macro

Down Hor up

INF

Multi-spot

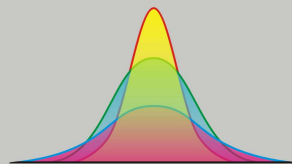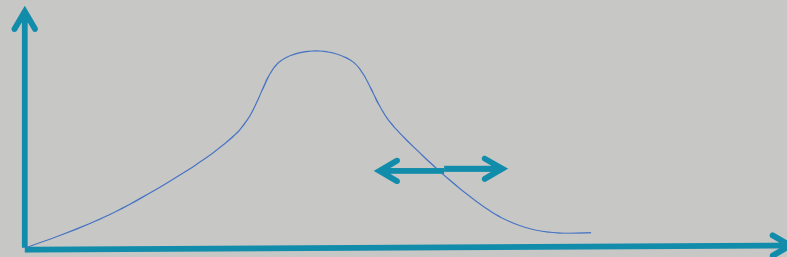| 1	2	3
4	5	6
7	8	9

Continue AF:

- Scene Change detection + Single autofocus

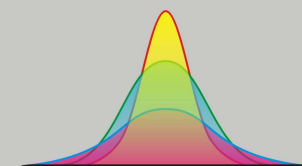- Scene Change detection + Direction Judgement + peak finding.

Scene Change detection:

- Luma change and FV change :
- additional sensor such as Gyro

THANKS

本课程由 Maver Jiang提供

大话成像之
数字成像系统 32 讲

内容目录