SECR

MEMS-sensors
in Computer Vision:
we underestimate them

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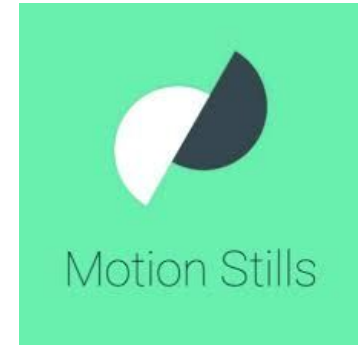
Video stabilization

- Good frame quality

- Bad video quality

- Reason — **jitter**

Existing solutions

- Mechanical devices

- OIS

- Digital stabilization

Digital stabilization

Disadvantages

- Based on frame scanning

- Slow processing

- Poor lightning

- Big moving objects

How to detect motion?
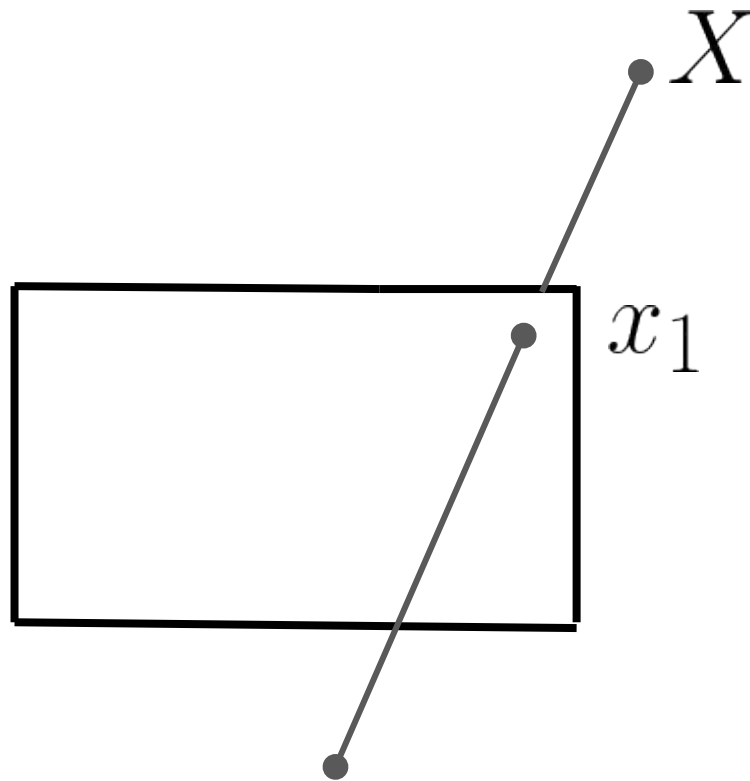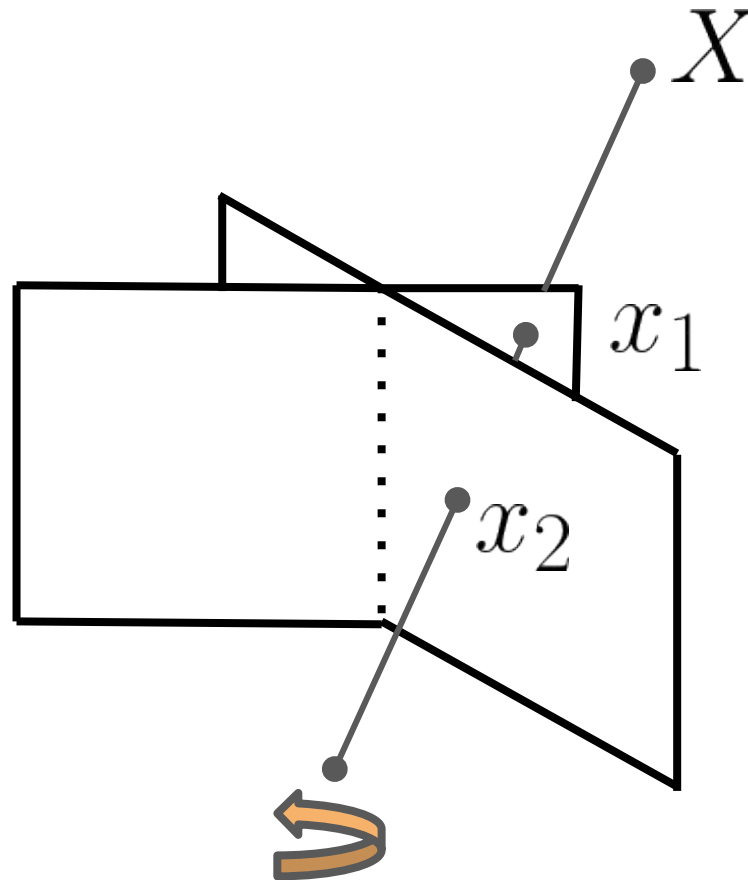
Gyroscope

Accelerometer

Using MEMS-sensors

- Instantly

- Power consumption — 2-5 mW

- Widely used
  - Smartphones
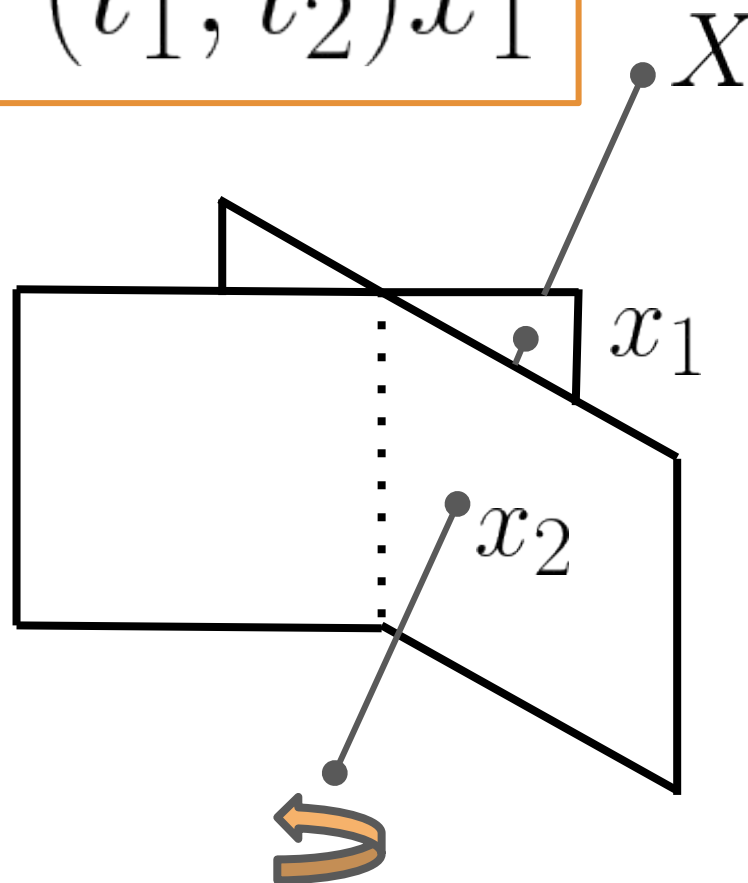 - Embedded systems

Camera rotation model

Camera rotation model

Camera rotation model
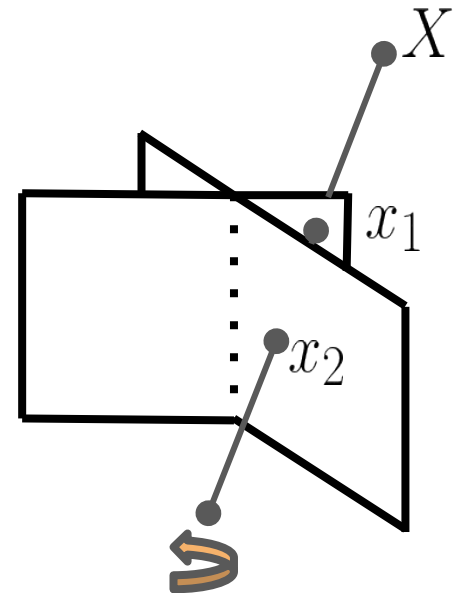
$$x_2 = W(t_1, t_2)x_1$$

Depends on rotation

$$x_2 = W(t_1, t_2, R)x_1$$

Gyro info

Rotation matrix

X

x_1

x_2

Gyroscope model

- Angular velocity
- Integrate
  - Timestamps
- 1D-rotation

$$tilt = tilt_{prev} + \omega \Delta t$$
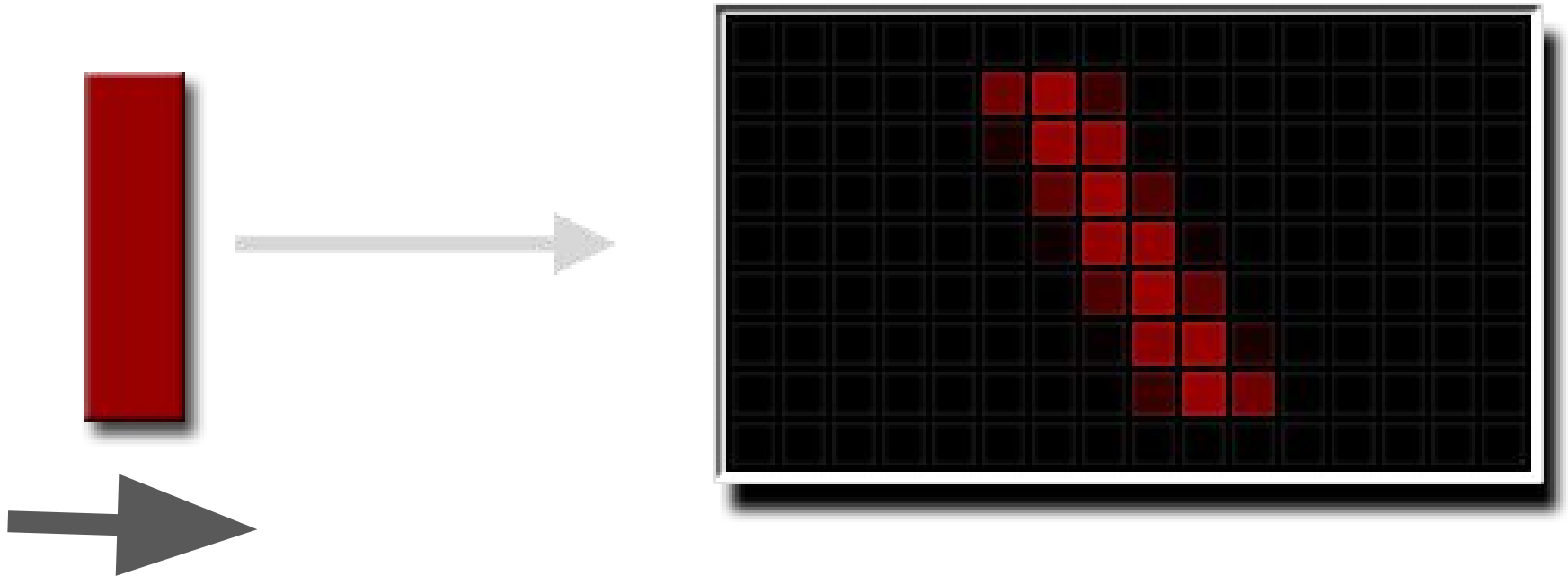
Example

http://bit.ly/kornilova_secr2017

More complex integration

- *"Digital Video Stabilization and Rolling Shutter Correction using Gyroscopes"* (2012, Standford)

- Quaternions

- 3D-rotation

Example

http://bit.ly/kornilova_secr2017
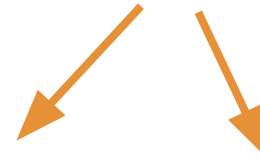
Rolling shutter defect

Rolling shutter model

$$x_2 = W(t_1, t_2)x_1$$
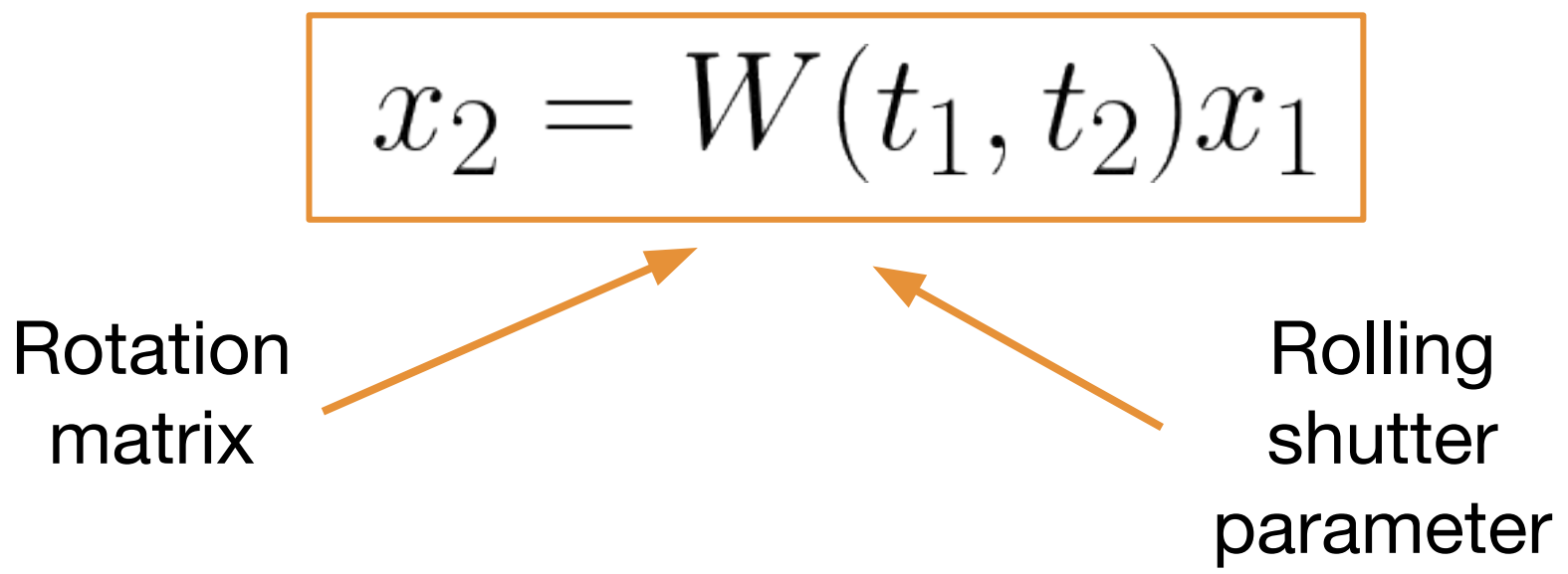
Row of point

$$x_2 = W(t_1, t_2, R, i)x_1(i)$$

Generalize

$$x_2 = W(t_1, t_2)x_1$$

Rotation matrix

Rolling shutter parameter

Oops... Auto calibration

$$x_2 = W(t_1, t_2)x_1$$

Rotation matrix

Rolling shutter parameter

- Focal length
- Camera and sensor displacement
- Synchronization sensor and camera
- Bias of gyroscope

Example. 20 usec!!!

http://bit.ly/kornilova_secr2017

Conclusion

- Real-time available

- Simple model, but many problems

- Codecs

- 3D-reconstruction

Q&A

Video stabilization
using MEMS-sensors
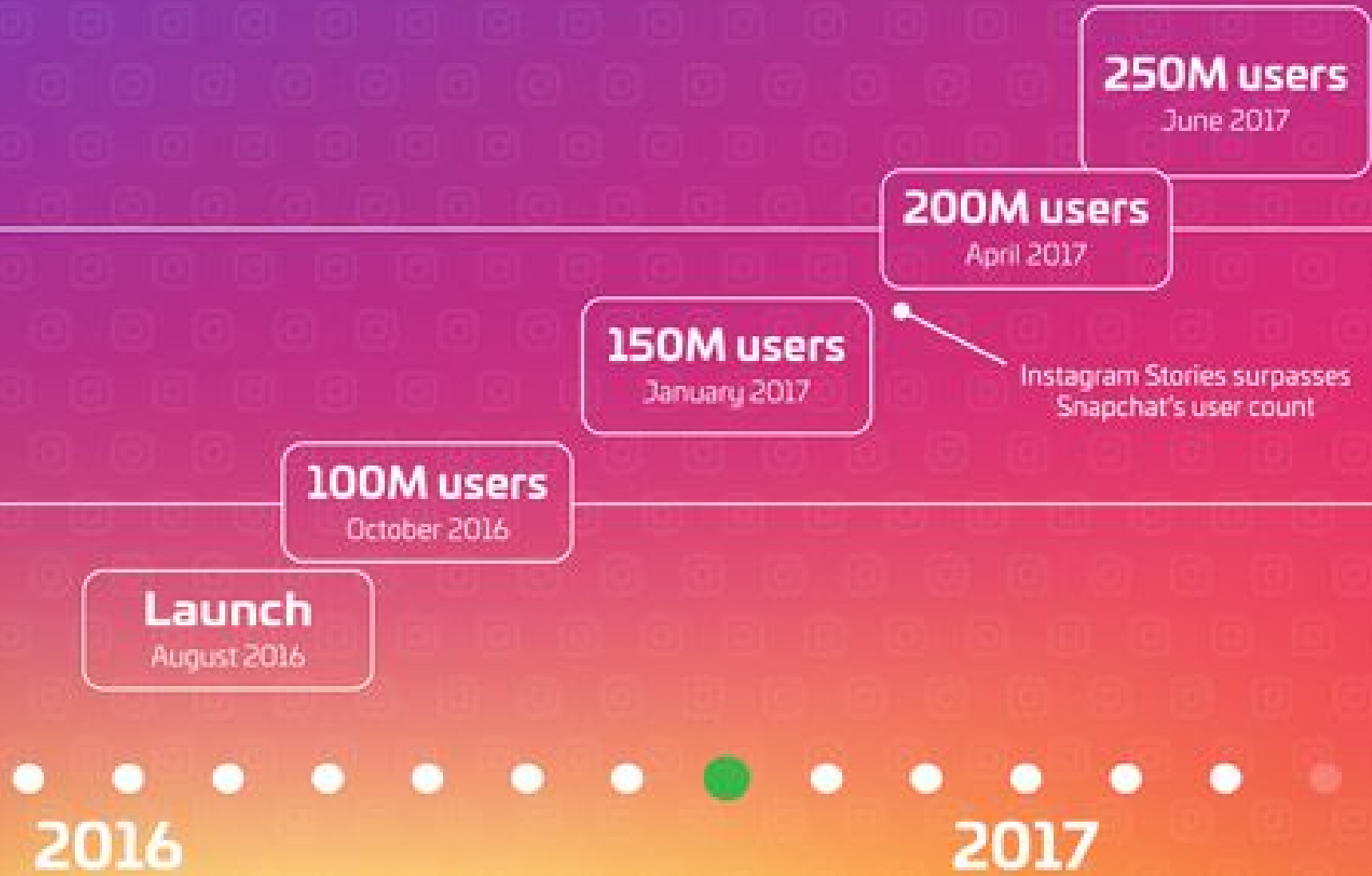http://bit.ly/kornilova_secr2017

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Appendix

Instagram Stories Daily Active Users

250M users
June 2017

200M users
April 2017

150M users
January 2017

Instagram Stories surpasses
Snapchat's user count

100M users
October 2016

Launch
August 2016

2016

2017

Statistics

- **Whatsapp**: 250 million messages with video per day
- **Periscope**: 350 000 hours streamings per day
- **Snapchat**: 6 billion videos per day

Mobile video editors

	iMovie	PowerDirector	CameraPlus Pro	Camera Genius
$	4$	3.5$	3.5$	3$
👥	30 млн	10 млн	5 млн	3 млн