Tracking Fast Moving Objects by Segmentation Network

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Introduction

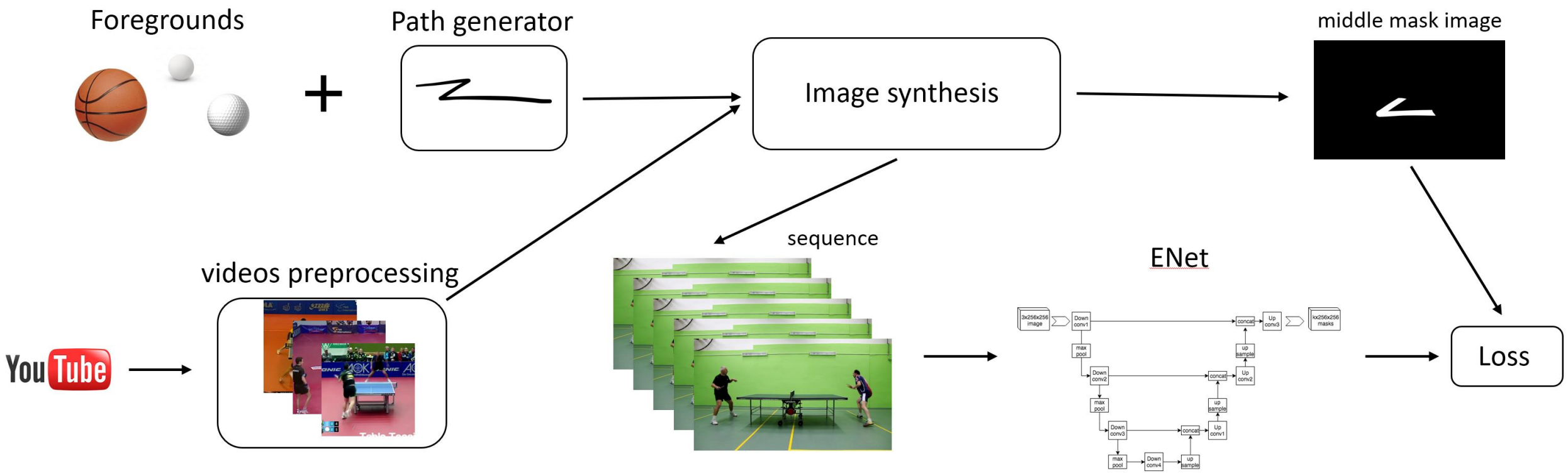
- World of FMO
  - Issues
  - Challenges
- Motivation
  - Sport video analysis
  - Camera tracking

Introduction

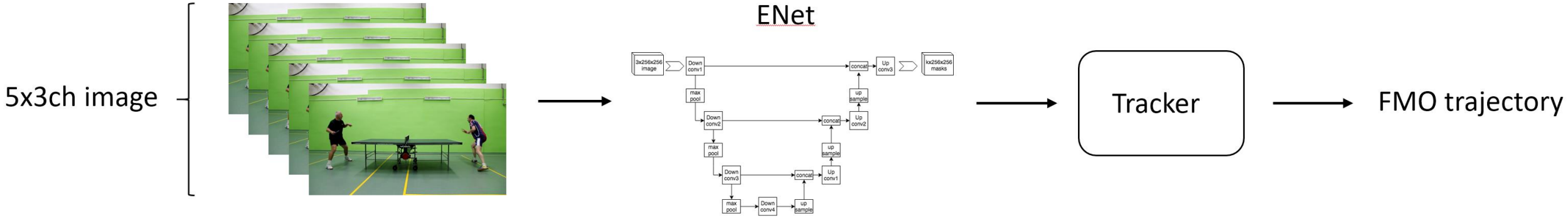
- Previous SOTA
  - Combination of background subtraction and deconvolution cycles
  - Relatively slow (4sec/frame mean time)
  - D. Rozumnyi, J. Kotera, F. Sroubek, L. Novotny, and J. Matas, "**The world of fast moving objects**," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2017, pp. 5203–5211.

- Our approach based on segmentation network
  - Superior inference speed
  - But necessity of annotated dataset
  - Consists of synthetic data generator, U-Net type network and Basic Tracker

Training



Inference

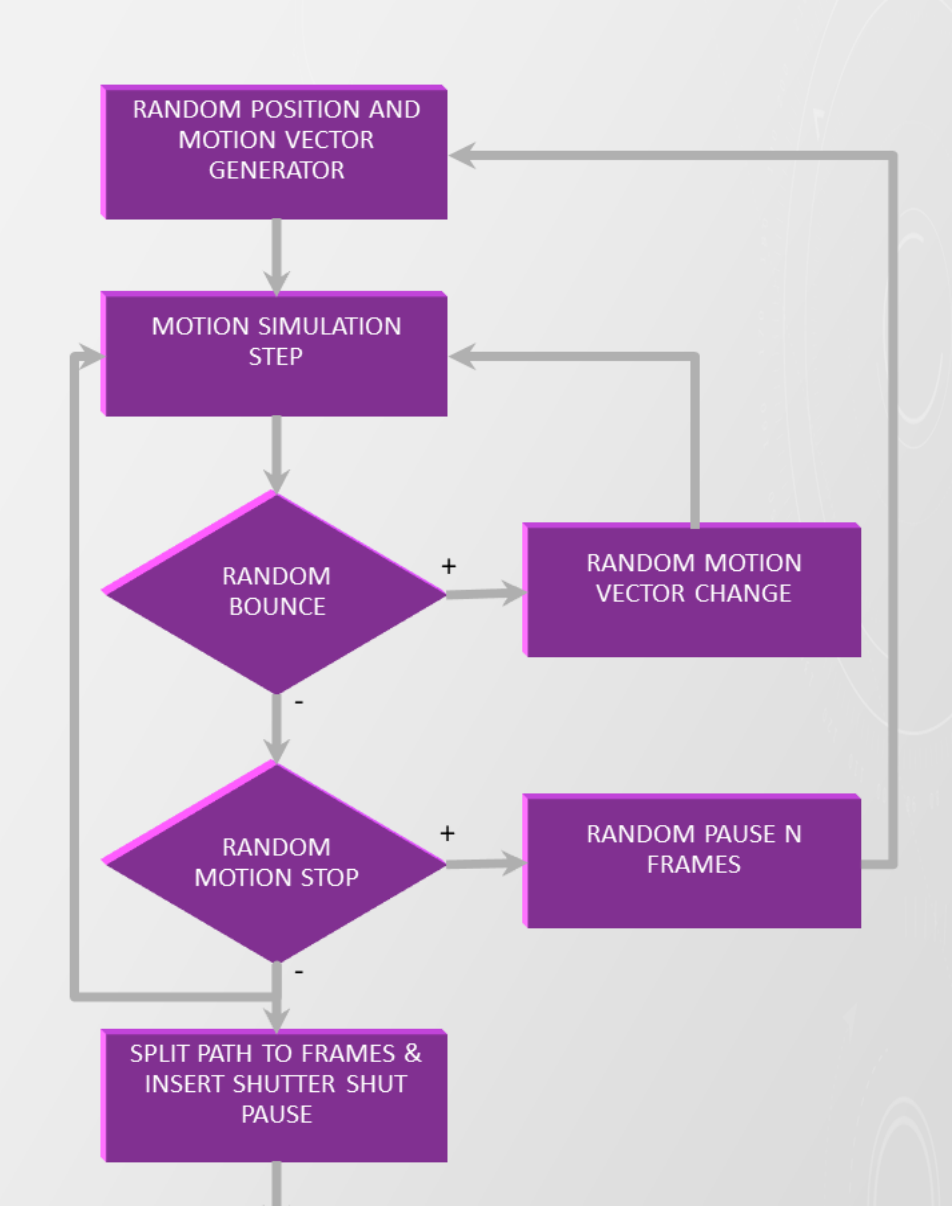


FMO sequence generator

- Background generation
  - YouTube sport video sequences
  - filtered by median to remove ball motions
- Motion generation
- Frames composition

FMO sequence generator

- Background generation
- Motion generation
  - Includes non-linear trajectories
  - Iterative simulation of motion
  - Bounces and sudden stops
- Frames composition



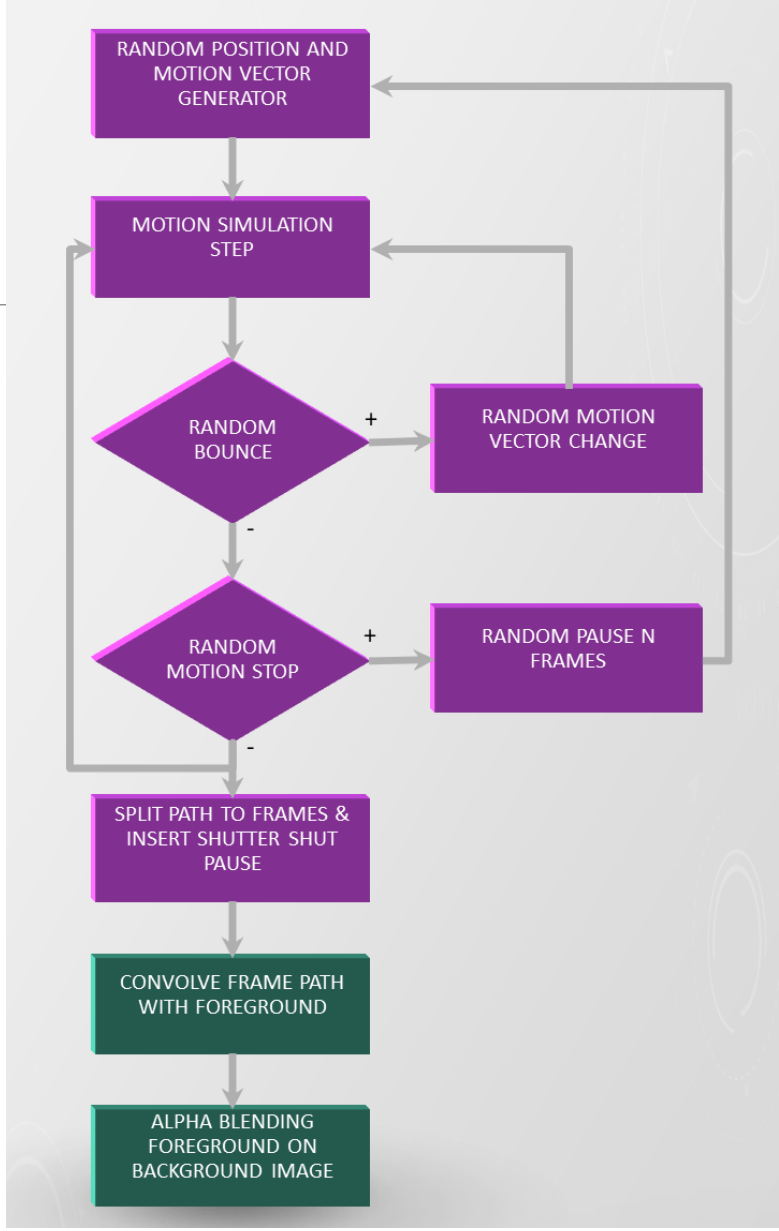
FMO sequence generator

- Background generation
- Motion generation
- Frames composition
  - Shutter gap

$$I_t(x) = [P_t * b_f F](x) + (1 - [P_t * M])B(x)$$

FMO sequence generator

- Background generation
- Motion generation
- Frames composition



FMO Tracking

- Blob selection
- Simple tracker
  - Kalman filter for prediction and interpolation

Results & Examples

		original work			Learning-based I		
	n	Pr.	Rec.	F1	Pr.	Rec.	F1
volleyball	50	100	45.5	62.5	0	0	0
volleyball passing	66	21.8	10.4	14.1	**20**	**16.2**	**17.9**
darts	75	100	26.5	41.7	37	**62.5**	**46.5**
darts window	50	25	50	33.3	**33.3**	33.3	33.3
softball	96	66.7	15.4	25	**83.3**	**83.3**	**83.3**
archery	119	0	0	0	**25**	**20**	**22.2**
tennis serve side	68	100	58.8	74.1	66.7	**76.9**	71.4
tennis serve back	156	28.6	5.9	9.8	**35.3**	**69.2**	**46.8**
tennis court	128	0	0	0	**33.3**	**40.8**	**36.7**
hockey	350	100	16.1	27.7	24.1	**86.7**	**37.7**
squash	250	0	0	0	**26**	**84.4**	**39.7**
frisbee	100	100	100	100	0	0	0
blue ball	53	100	52.4	68.8	40	26.7	32
ping pong tampere	120	100	88.7	94	58.6	66.7	62.4
ping pong side	445	12.1	7.3	9.1	**45.4**	**79.1**	**57.7**
ping pong top	350	92.6	87.8	90.1	56	**98.9**	71.5
Average per frame	2476	53.7	31	35.5	38.3	**68.5**	**47.2**

Results & Examples

video resolution	average fps
864 x 1536	2
576 x 1024	4.7
430 x 768	8.6
324 x 576	11.8
216 x 384	23.1

Results & Examples

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Thank you

If you have any questions, please send an e-mail to
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