

Counting People Crossing a Line using Integer Programming and Local Features

Zheng Ma, *Member, IEEE*, Antoni B. Chan, *Senior Member, IEEE*

APPENDIX A

L1 NORM FORMULATION AS A LINEAR PROGRAM

Introducing, an auxiliary variable $t \in (\mathbb{Z}^+)^N$, (5) is equivalent to

$$\min_{s,t} \sum_{i=1}^N t_i \quad (\text{A-1})$$

$$\text{s.t. } s_j \in \mathbb{Z}^+, \forall j, \quad (\text{A-2})$$

$$\text{s.t. } |a_i s - \hat{n}_i| \leq t_i, \quad (\text{A-3})$$

which can be rewritten in the form of a standard linear program,

$$\min_x f^T x \quad \text{s.t. } Cx \leq b \quad (\text{A-4})$$

where

$$x = \begin{bmatrix} s \\ t \end{bmatrix} \in (\mathbb{Z}^+)^{M+N}, \quad f = \begin{bmatrix} 0_M \\ 1_N \end{bmatrix} \in \mathbb{Z}^{M+N}, \quad (\text{A-5})$$

$$C = \begin{bmatrix} -A & -I_N \\ A & -I_N \end{bmatrix} \in \mathbb{Z}^{(M+N) \times 2N}, \quad b = \begin{bmatrix} -\hat{n} \\ \hat{n} \end{bmatrix} \in \mathbb{Z}^{2N}, \quad (\text{A-6})$$

and 0_M is the vector of M zeros, 1_N is the vector of N ones, and I_N is the $N \times N$ identity matrix.

APPENDIX B

ADDITIONAL RESULTS ON GRAND CENTRAL DATASET

Figure A-1 shows the temporal slice images and instantaneous counts for 3 lines in the Grand Central dataset. Figures A-2 and A-3 show the cumulative count and instantaneous counts on Grand Central.

APPENDIX C

RESULTS USING DPM DETECTION

Figure A-4 shows the DPM people detection results on the temporal slice image for UCSD and LHI. Figure A-5 shows the instantaneous and cumulative counting results.

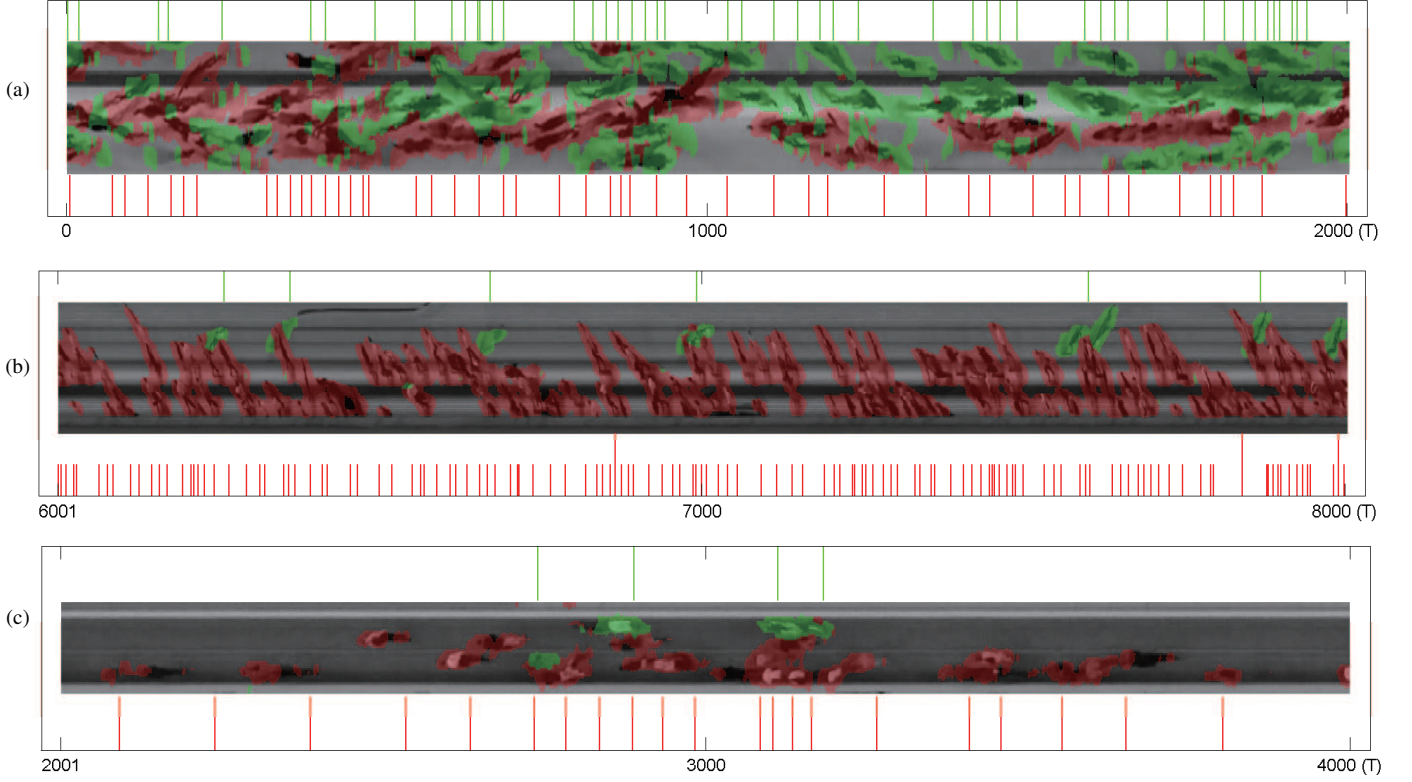


Fig. A-1. Results of instantaneous count estimation on Grand Central dataset: a) L1 frame 1 to 2000 and b) L4 frame 6001 to 8000 c) L8 frame 2001 to 4000. The image is a temporal-slice of the video on the LOI. The red and green segments correspond to crowds moving in different directions, and the instantaneous count estimates appear above and below the image.

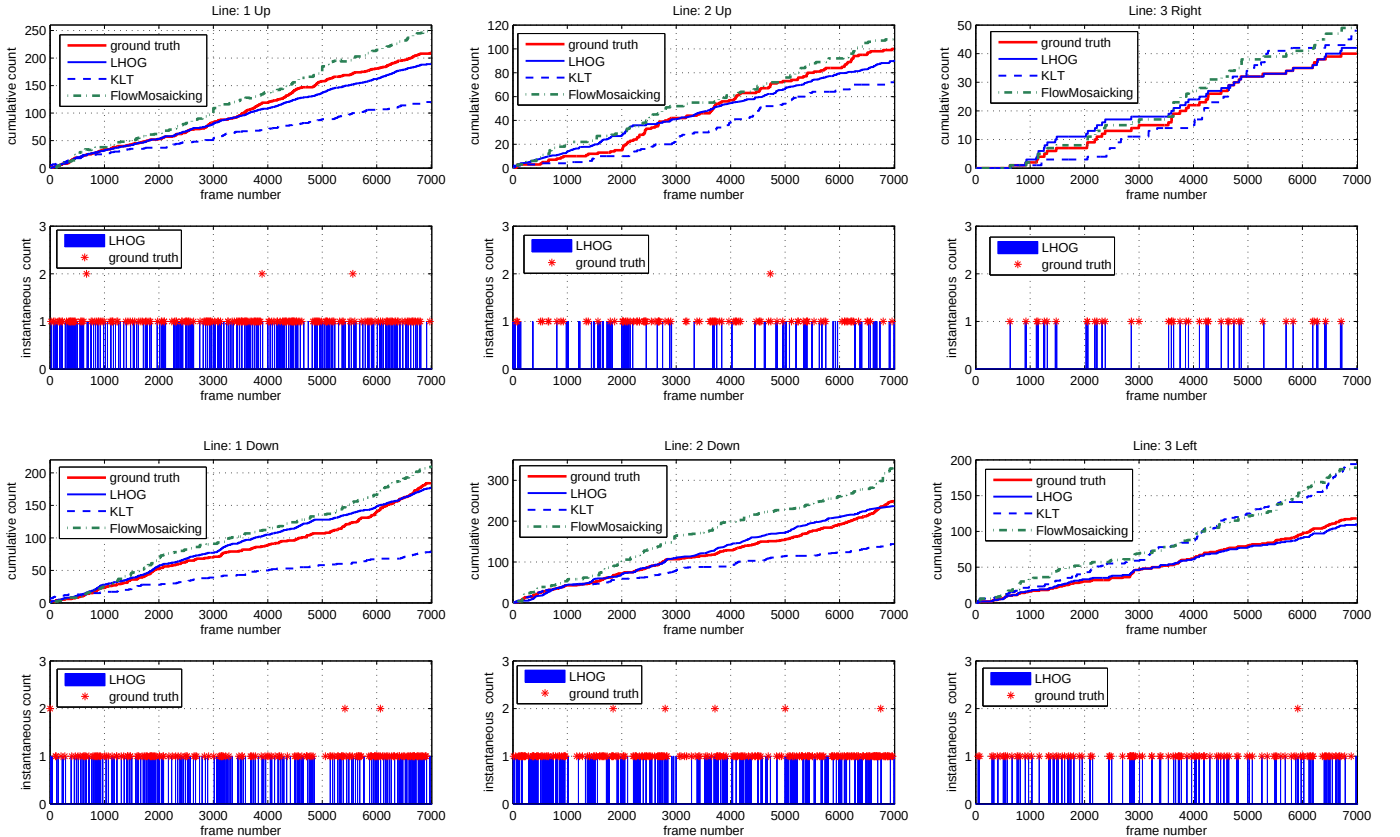


Fig. A-2. Line counting results using LHO and KLT on Grand Central dataset (lines L1-L3).

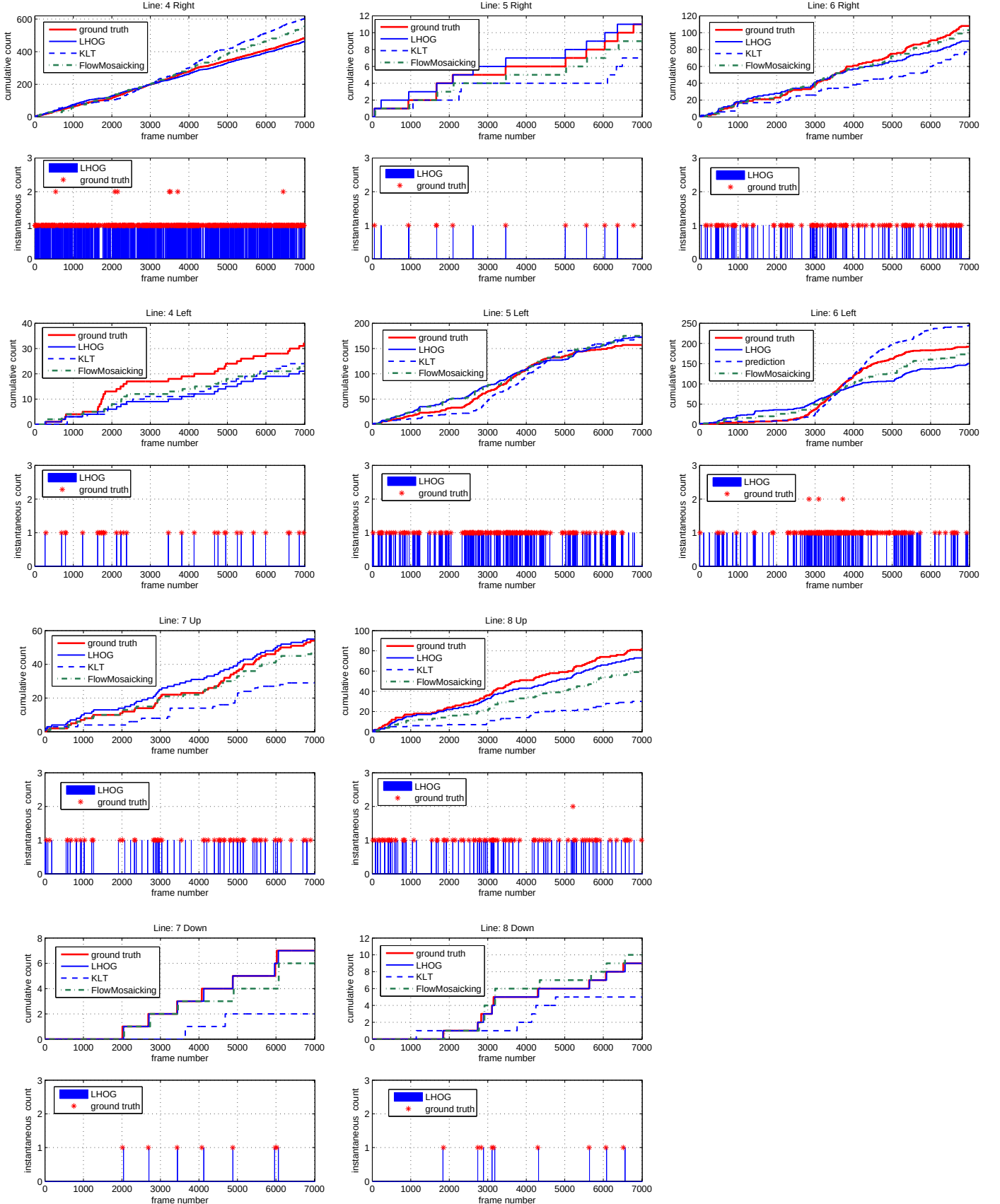


Fig. A-3. Line counting results using LHOg and KLT on Grand Central dataset (lines L4-L8).

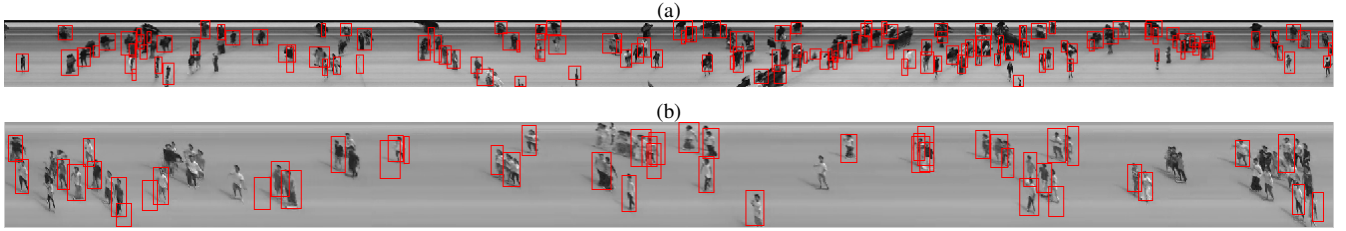


Fig. A-4. DPM detector results on temporal slice image a) UCSD dataset, and b) LHI dataset.

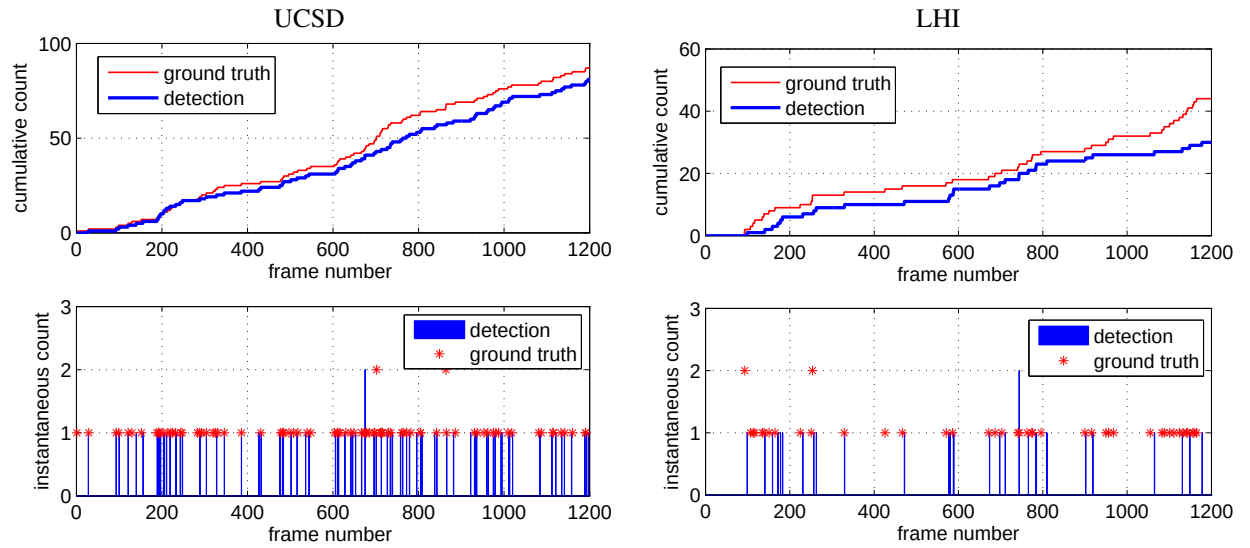


Fig. A-5. Cumulative and instantaneous counting results for DPM on (left) UCSD, and (right) LHI datasets.