# People Counting Data for PETS 2009 dataset

Antoni Chan (abchan - AT - ucsd.edu)
Department of Computer Science, City University of Hong Kong

Nuno Vasconcelos (nuno - AT - ece.ucsd.edu)
Dept. of Electrical and Computer Engineering, University of California, San Diego

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This archive contains the feature and count data used in [1] for crowd counting on the PETS 2009 dataset. It also contains the segmentations and ground-truth annotations. Most of the files are formatted in a similar way to the UCSD datasets. You can find more information on the method in [1, 2, 3], or online at [5, 6, 7]. If you use this data, please cite [1]. The original PETS video data is available at [4].

## 1 Feature and Count Data

The feature and count data (used for count regression) are located in the `features` directory. Data for the following 6 videos is available:

| index | video name |
|---|---|
| 1 | S1.L1 13-57 |
| 2 | S1.L1 13-59 |
| 3 | S1.L1 14-03 (first 200 frames) |
| 4 | S1.L1 14-03 (remaining frames) |
| 5 | S1.L2 14-06 |
| 6 | S1.L3 14-17 |

The data is separated into different MATLAB files by region-of-interest (R0, R1, R2), and each file contains the feature vectors, counts, and evaluation set (training and test set) for that region-of-interest:

| file | description |
|---|---|
| `pets2009_R0_feats.mat` | features and counts for R0 region |
| `pets2009_R1_feats.mat` | features and counts for R1 region |
| `pets2009_R2_feats.mat` | features and counts for R2 region |

Here is a detailed description of the contents of each file:

| | |
|---|---|
| `dirs{j}` | the name for direction j. |
| `fv{j}{v}` | [30 x nv] matrix of feature vectors for direction j in video v. nv is the number of frames in video v. each column is a feature vector. |
| `cnt{j}{v}` | [1 x nv] matrix of true counts for direction j in video v. |
| `evalsets{n}` | set of training/test frames for evaluation. Each cell uses a different video as the test set. |
| `evalsets{n}.trainset`<br>`evalsets{n}.testset`<br>`evalsets{n}.loghyper{j}` | video indices for the training set.<br>video index for the test set.<br>the log hyperparameters learned in [1] for direction j. |
| `vids{v}`<br>`locs{j}{v}` | name of video v<br>raw locations used for ground-truth data for direction j in video v. Each entry contains the people coordinates in one frame. Every 5 frames were marked, and the counts in other frames were interpolated from these. |

The feature vector is described in the next section. See [1] for more information about the evaluation sets and ground-truth annotations.

### 1.1 Features

The features were extracted from the corresponding motion segments in the video, using the provided region-of-interest and density maps (see next section). The following table lists contents of the feature vector used.

| | **feature description** | feature dimension |
|---|---|---|
| segment | segment area | 1 |
| | segment perimeter | 2 |
| | perimeter orientation histogram (90 degrees) | 3 |
| | perimeter orientation histogram (120 degrees) | 4 |
| | perimeter orientation histogram (150 degrees) | 5 |
| | perimeter orientation histogram (0 degrees) | 6 |
| | perimeter orientation histogram (30 degrees) | 7 |
| | perimeter orientation histogram (60 degrees) | 8 |
| | perimeter-area ratio | 9 |
| | Blob count | 10 |
| edge | internal edge length | 11 |
| | internal edge orientation histogram (90 degrees) | 12 |
| | internal edge orientation histogram (120 degrees) | 13 |
| | internal edge orientation histogram (150 degrees) | 14 |
| | internal edge orientation histogram (0 degrees) | 15 |
| | internal edge orientation histogram (30 degrees) | 16 |
| | internal edge orientation histogram (60 degrees) | 17 |
| | Minkowski dimension of internal edges | 18 |
| texture | GLCM energy (0 degrees) | 19 |
| | GLCM homogeneity (0 degrees) | 20 |
| | GLCM entropy (0 degrees) | 21 |
| | GLCM energy (45 degrees) | 22 |
| | GLCM homogeneity (45 degrees) | 23 |
| | GLCM entropy (45 degrees) | 24 |
| | GLCM energy (90 degrees) | 25 |
| | GLCM homogeneity (90 degrees) | 26 |
| | GLCM entropy (90 degrees) | 27 |
| | GLCM energy (135 degrees) | 28 |
| | GLCM homogeneity (135 degrees) | 29 |
| | GLCM entropy (135 degrees) | 30 |

It is advised to normalize each dimension of the feature vector to have zero mean and unit variance. The normalization parameters should be calculated from the training set only.

### 1.2 Example Experiments

The archive includes a MATLAB script `run_experiment_pets2009.m` for running the experiments from [1]. This script requires the utility functions from features archive of the UCSD dataset. The code also uses the GPML toolbox [8] for learning the GP regression function (results here use version 3.2). Counting results on all the videos are summarized below. Results differ slightly from [1] due to a small change in handling redundant features. Note that the total here means the total count, by summing up the left and right predictions.

| | | total | | right | | left | |
|---|---|---|---|---|---|---|---|
| video | region | \|error\| | MSE | \|error\| | MSE | \|error\| | MSE |
| S1.L1 13-57 | R0 | 2.3077 | 8.3620 | 0.2489 | 0.3394 | 2.4751 | 8.9548 |
| S1.L1 13-57 | R1 | 1.6968 | 5.0000 | 0.0995 | 0.0995 | 1.6425 | 4.7195 |
| S1.L1 13-57 | R2 | 1.0724 | 1.7421 | 0.2353 | 0.3167 | 0.8597 | 1.5385 |
| S1.L1 13-59 | R0 | 1.6473 | 4.0871 | 1.6680 | 4.1577 | 0.1535 | 0.1535 |
| S1.L1 13-59 | R1 | 0.6846 | 1.1162 | 0.5892 | 0.8714 | 0.0954 | 0.0954 |
| S1.L1 13-59 | R2 | 1.2822 | 2.5768 | 1.2905 | 2.4357 | 0.0664 | 0.0664 |
| S1.L2 14-06 | R1 | 4.3284 | 44.1592 | 4.3383 | 44.1592 | 0.0050 | 0.0050 |
| S1.L2 14-06 | R2 | 3.1542 | 26.1592 | 3.1841 | 26.5970 | 0.0249 | 0.0348 |
| S1.L3 14-17 | R1 | 0.6044 | 1.2198 | 0.6044 | 1.1978 | 0.0000 | 0.0000 |

Table 1: Counting results on PETS2009 using [1]

## 2 Segmentations

The segmentations are in the `segm/pets2009` directory. The segmentations are saved as directories of png images.

| Name | Description |
|---|---|
| `segm/pets2009/S1L1-13-57.segm` | Segmentation for S1.L1 13-57 |
| `segm/pets2009/S1L1-13-59.segm` | Segmentation for S1.L1 13-59 |
| `segm/pets2009/S1L1-14-03a.segm` | Segmentation for S1.L1 14-03 (first 200 frames) |
| `segm/pets2009/S1L1-14-03b.segm` | Segmentation for S1.L1 14-03 (remaining frames) |
| `segm/pets2009/S1L2-14-06.segm` | Segmentation for S1.L2 14-06 |
| `segm/pets2009/S1L3-14-17.segm` | Segmentation for S1.L3 14-17 |

## 3 Ground-truth annotations

The ROI and density maps are provided in the `gt/pets2009` directory. The format is the same as those in the UCSD annotations.

## 4 Acknowledgments

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# 5 History

- 2014/03/18 - added ground-truth count for R2 of S1.L3 14-17. Originally, there was no ground-truth counts annotated for R2 in video S1.L3 14-17 because it was not evaluated in the PETS 2009 workshop. The ground-truth for R2 has been generated from the people locations in R0.
- 2013/02/28 - initial version

# References


[1] A. B. Chan, M. Morrow, and N. Vasconcelos, "Analysis of Crowded Scenes using Holistic Properties," in *11th IEEE Intl. Workshop on Performance Evaluation of Tracking and Surveillance (PETS 2009)*, Miami, Jun 2009.

[2] A. B. Chan, Z. S. J. Liang, and N. Vasconcelos, "Privacy Preserving Crowd Monitoring: Counting People without People Models or Tracking," In *IEEE Conference on Computer Vision and Pattern Recognition*, June 2008.

[3] A. B. Chan and N. Vasconcelos, "Counting People with Low-Level Features and Bayesian Regression," *IEEE Trans. on Image Processing*, vol. 21(4), pp. 2160-77, April 2012.

[4] http://www.cvg.rdg.ac.uk/PETS2009/

[5] http://www.svcl.ucsd.edu/projects/crowds

[6] http://www.svcl.ucsd.edu/projects/peoplecnt

[7] http://visal.cs.cityu.edu.hk/research/peoplecnt/

[8] http://www.gaussianprocess.org/gpml/code/