Learning and Inferring Motion Patterns using Parametric Segmental SLDS
- Guides for using Executables and Data -

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1 Introduction

This note is intended to describe the functionality of the binary codes and data provided as a supplemental materials for the research work "Learning and Inferring Motion Patterns using Parametric Segmental SLDS" which is to appear in International Journal of Computer Vision, special issue on Learning for Vision. The supplemental materials include the following (as of June 15th, 2006) :

1. Binary file that allows users to exactly repeat the experiments presented in the paper (main.exe).
2. Experimental Data (labeled honey bee trajectories) that was used in the experiments described in the paper.
3. More flexible binary file, main2.exe, that allows users to learn motion parameters from arbitrary set of training data (labeled honey bee trajectories) and to automatically label arbitrary set of testing data (unlabeled honey bee trajectories).
4. General binary file that can learn SLDS parameters from more general set of data, other than honey bee trajectories, is scheduled to be included in Fall, 2006.

The installation instruction for Linux Redhat machines (currently only support Redhat 9.0 and Pentium 4 machines, more supports will be released) is described in Sec. 2. The files in "psslds.tar.gz" are described in detail in Sec. 3.

Then, the data (labeled honey bee dance trajectories) and the format is described in Sec. 4. Then, the instructions to repeat the experiments in the paper are presented in Sec. 5. More general form of binary which can learn parameters from arbitrary sets of training data, and can label any honey bee dance trajectories is described in 6.

2 Installation

Please unzip 'deliverables.tar.gz' file at your convenience directory. There's no further compilation required. The executables './executable/main.exe' and './executable/main2.exe' are binary files.

The required execution environment are as follows :

- Linux Redhat 9.0 or compatible OS.
- Pentium 4 processor (the current executable does not run on Pentium 3).
- IPP 4.1 library.

Once you unzipped and installed the deliverables, you need to set up the IPP libary path. The executable looks into the environmental variable named 'LD_LIBRARY_PATH'. IPP libraries are required as the executables support GUI based experiments. The executables without GUIs are going to be provided for easier use soon.

For example, if you have your ipp 4.1 library at /net/ipp-3.0/sharedlib, please set the path has follows :

* in bash shell:
LD_LIBRARY_PATH=${LD_LIBRARY_PATH}:/net/ipp-3.0/sharedlib

* in csh or tcsh shells:
setenv LD_LIBRARY_PATH /net/ipp-3.0/sharedlib:$LD_LIBRARY_PATH

3 Contents

The downloadable "deliverables.tar.gz" file has following subdirectories zipped in it.

3.1 Subdirectory ./data

Subdirectory ./data contatins the following 3 categories of subdirectories which stores different sorts of data.

- ./sequence1 - ./sequence6 contains 6 honey bee dance tracks used in the experiments in the paper. The data are in BioTracking Format (BTF) which is tobe described in Sec. 4.
- ./labels contains the inferred label results presented in the paper. Once you run the executable 'main.exe', same results are going to be stored in this directory.
- ./params contains binary parameter values that are learned from the data.

3.2 Subdirectory ./executable

Subdirectory ./executable contains two pairs of executable (.exe) and parameter files (.mdl).

- main.exe is included for the users to repeat the experiment in the paper easily. The parameters used in the experiment in the paper are stored in psslds.mdl file. Hence, running main.exe with psslds.mdl without modifing the parameters will exactly repeat the experiments.
- main2.exe is included for the users to apply the presented algorithm to an extended set of data. psslds2.mdl file is a pair file where the users can specify where the data are located and tune parameters. The executable main2.exe is currently tailored to work with honeybee dance trajectories in BTF format. More general executable (possibly with source codes written in caml codes) that can work on broader forms of data will be released soon.

4 Data

The honey bee dance trajectories are stored in BTF format standardized at GeorgiaTech BORG lab. Below, the format is briefly introduced and readers who are interested in more details are referred to http://borg.cc.gatech.edu/Software/gtrack/btf.html.

Basically, each honey bee dance trajectories are stored in the same directory where each file (.btf) contains one field of data. For example, in PS-SLDS work, the honey bee dance trajectory is a time series of (x,y,theta) data where (x,y) is the coordinate of a bee and theta is the heading angle at the corresponding moment. The data corresponding to these three fields are stored in ximage.btf, yimage.btf, and timage.btf respectively. There is a file named label0.btf which stores the ground-truth label at that moment. Every line in these files correspond to same time-stamp. Once inference is performed the results are stored in different files, e.g., psslsdsViterbi.btf.

5 main.exe Instruction

The executable main.exe is provided for the users to repeat the experiments in the paper. You can test the performance of three methods step by step following the instructions below. The three methods are :

1. SLDS Viterbi
2. SLDS Variational
3. PS-SLDS Viterbi

First, in the subdirectory /executable/, type the following command to run the main program :
./main.exe psslds.mdl

Then, a GUI will pop up. The subsequent menus at the top of the GUI are described in the following subsections.

5.1 Menu Data

You can view the preprocessed data by clicking :

- Data -> View Original Data : shows datasets for SLDS learning and inference.
- Data -> View PS-SLDS Training Data : shows datasets for PS-SLDS learning and inference. Additional rotation preprocessing has been done on these datasets to align the dances.

5.2 Menu Learning

In the 'Learning menu' there are three sub-menus : SLDS, S-SLDS, PS-SLDS. Please click these three menus from top to the bottom. Then the system learns the parameters of SLDS, S-SLDS, PS-SLDS models.

Note that it's important to execute them in order. This is required because SLDS parameters are used as part of the S-SLDS parameters. Similary, S-SLDS parameters are used as part of the PS-SLDS model parameters.

5.3 Menu Inference

The three inference methods, i.e., SLDS Viterbi/Variational, PS-SLDS Viterbi, are tested in top menu 'SLDS' and 'PS-SLDS' respectively.

It is again important to run these inference methods in order, for the same reason. I.e., SLDS Viterbi inference results are used as a part of the initialization points for SLDS Variational approximation methods. Some of the intermediate results of SLDS inference methods are used for PS-SLDS inference as well.

5.3.1 SLDS Viterbi

Click SLDS -> Approximate Viterbi all.

Then all six SLDS inference results will pop up in colors for qualitative analysis.

5.3.2 SLDS Variational

Click SLDS -> Variational all.

Then, all six SLDS inference results will pop up in colors for qualitative analysis. You can see that the color strips evolve as the variational approximation iterations proceed.

5.3.3 PS-SLDS Viterbi

First, you need to find the initialization priors for PS-SLDS inference.

To do this, please click PS-SLDS -> S-SLDS all. This process may take several munites depending on the performance of your machine.

Once the initialization is done and ready, please click PS-SLDS -> PS-SLDS Viterbi all. Then, PS-SLDS inference starts and goes over all six data sequence one by one. The final results will pop up when the EM iterations are done.

Again, this process may take several munites depending on the performance of your machine. E.g, it takes about one and half hour in total for PS-SLDS inference results to be converged for all six data sequences.

5.4 Menu Results

You can view all the results (SLDS VIterbi, SLDS VA, PS-SLDS Viterbi and Ground truth labels) in colors by clicking :

- Results -> Everything.

The inference results which was presented in the submission will show up for all six data sequences.

6 main2.exe Instruction

The executable main2.exe is provided to support users who applies the algorithm with an extended set of honey bee dance data. In detail, there are fields in the provided psslds2.mdl file : Nature.testing_seq_file which is set to be 'test_seq.txt' file & Nature.training_seq.txt set to be 'training_seq.txt' file. In this case, test_seq.txt file contains the list of directories where the training files are located and training_seq.txt for training files. For example, the training_seq.txt file included in the same directory (./executable) with psslds2.mdl point to ../data/sequence1/btf, ../data/sequence2/btf and so on. Hence any honey bee dance data stored in the right BTF format with (ximage.btf, yimage.btf, timage.btf, label0.btf) can be used as one of the training sequences and data without (label0.btf) can be used to as part of the test data.

6.1 Menu PS-SLDS

PS-SLDS menu is designed to help the users to easily do experiments with BTF data. It has 5 menus described below.

- Load Test Data : loads all the BTF test data whose paths are stored in the file specified in Nature.testing_seq_file filed in psslds2.mdl file.
- Load Training Data : loads all the BTF training data whose paths are stored in the file specified in Nature.training_seq_file field in psslds2.mdl file.

- Load Parameter Data : loads saved PS-SLDS parameters at a location specified by the field 'Nature.param_file' in psslds2.mdl file. In fact, this field is where learned parameters are stored as well. The users can change this field interactively by clicking the properties menu in GUI and the appropriate field.
- Learn from Training Data : PS-SLDS parameters are learned from the training data. Note that the training data are required to be loaded up prior to this menu.
- Segment Data : loaded up testing data are automatically labeled based on the currently loaded parameters. The inferred labels are stored as 'label0.btf' in the corresponding directory.

6.2 Menu View

The View menu is provided to help the users visualize the original labeling results of training data as well as newly inferred labels of testing data. When 'label0.btf' is missing in the testing data directory, the trajectory is displayed in black color. Otherwise, the trajectories are colored in red (turn-right), blue (turn-left) and green (waggle).

There are Next, Prev, and Switch menu in the view menu.

Next displays next sequence (in the loop mode) and prev displays previous sequence and switch menu switches between training and testing sequences. Hence, the users can easily view the results of their data.

7 Q & A

If you have further questions, please contact the corresponding author, Sangmin Oh (sangmin@cc.gatech.edu).