

Introducing the Simulated Flying Shapes and Simulated Planar Manipulator Datasets

Fabio Ferreira^{*†}, Jonas Rothfuss^{*†}, Eren Erdal Aksoy^{*‡}, You Zhou^{*†} and Tamim Asfour[†]

Abstract— We release two artificial datasets, *Simulated Flying Shapes* and *Simulated Planar Manipulator* that allow to test the learning ability of video processing systems. In particular, the dataset is meant as a tool which allows to easily assess the sanity of deep neural network models that aim to encode, reconstruct or predict video frame sequences. The datasets each consist of 90 000 videos. The *Simulated Flying Shapes* dataset comprises scenes showing two objects of equal shape (rectangle, triangle and circle) and size in which one object approaches its counterpart. The *Simulated Planar Manipulator* shows a 3-DOF planar manipulator that executes a *pick-and-place* task in which it has to place a size-varying circle on a squared platform. Different from other widely used datasets such as moving MNIST¹ [1], [2], the two presented datasets involve goal-oriented tasks (e.g. the manipulator grasping an object and placing it on a platform), rather than showing random movements. This makes our datasets more suitable for testing prediction capabilities and the learning of sophisticated motions by a machine learning model. This technical document aims at providing an introduction into the usage of both datasets.

I. SIMULATED FLYING SHAPES

The dataset consists of 90 000 grayscale videos that show two objects of equal shape and size in which one object approaches the other one. The object speed during the process of approaching is hereby modeled by a proportional-derivative controller. Overall, three different shapes (rectangle, triangle and circle) are provided. Initial configurations of the objects such as the position or shape were randomly sampled. Different from the moving MNIST dataset, the samples comprise a goal-oriented task, namely one object has to fully cover the other object rather than randomly moving.

For instance, one can use this artificial dataset as a testbed to investigate the capacity and output behavior of a deep neural network before testing it on real-world data. In a preceding research project we trained a deep auto-encoder network on both datasets. In figure 1 we show exemplary input and the corresponding output generated by the network introduced in [3].

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[†]Institute for Anthropomatics and Robotics, Karlsruhe Institute of Technology, Karlsruhe, Germany.

[‡]School of Information Technology, Halmstad University, Sweden

*These authors contributed equally to this work.

¹http://www.cs.toronto.edu/~nitish/unsupervised_video

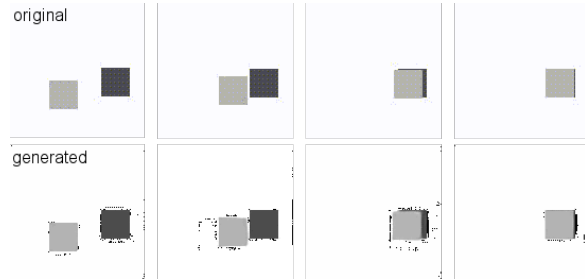


Fig. 1. Simulated Flying Shapes example. Top: original data as publicly provided. Bottom: output generated by a deep auto-encoder which was trained on the Simulated Flying Shapes dataset. A moving example can be obtained from the repository.

We provide both the videos as .avi files as well as TensorFlow tfrecord files. Access to the files is provided via a GitHub repository². The samples in the tfrecord files contain 10 frames of each original video which were taken equally distributed over their entire playtime. Additional technical information are provided in the following subsections.

A. Video File Specifications

The .avi video files have the following specifications:

- video resolution: 128×128
- fps: 30
- color depth: 24bpp (3 channels, grayscale)
- video codec: ffmpeg
- compression format: mjpeg
- color encoding: yuvj420p
- the samples follow the naming:
 - id.shape.startLocation.endLocation.motionDirection.euclideanDistance
- where:
 - id is a unique identifier
 - startLocation starting position of the object, e.g. righttop
 - endLocation: destination position of the object, e.g. leftbottom
 - motionDirection: motion direction of moving object, e.g. left
 - euclideanDistance: Euclidean distance between the two objects, e.g. 7.765617

B. tfrecord Specifications

The tfrecord files have been created with the pip package video2tfrecord and each file contains 1000 videos. Due

²<https://github.com/ferreirafabio/FlyingShapesDataset>

to the high computational cost of processing all original video frames in deep neural networks, we decided to reduce the number of extracted frames for the tfrecord files. As a result, every single tfrecord file entry consists of 10 RGB frames which were taken equally distributed over the video playtime. Assuming no prior knowledge about the video and its inherent scene dynamics, choosing frames equally spaced maximizes the chances of capturing most of the spatio-temporal dynamics. The files store both the videos itself and meta information from the file name (start location, eucl. distance etc.). The video data is stored in a *feature* dict which is serialized as `tf.train.Example` and contains the following keys:

- `feature['path']`
- `feature['height']`
- `feature['width']`
- `feature['depth']`
- `feature['id']`

Additional information is stored in a dictionary *meta_dict* which is also serialized within the *feature* dict, accessible by the key *metadata*. It contains the following additional keys:

- `meta_dict['start_location']`
- `meta_dict['end_location']`
- `meta_dict['motion_location']`
- `meta_dict['eucl.distance']`

II. SIMULATED PLANAR MANIPULATOR

The dataset consists of 90 000 color videos that show a planar robot manipulator executing articulated manipulation tasks. More precisely, the manipulator grasps a circular object of random color and size and places it on top of a square object/platform of again random color and size. The initial configurations (location, size and color) of the objects were randomly sampled during generation. Similarly to the Flying Shapes dataset, the samples again comprise a goal-oriented task as described above, making it highly suitable for testing prediction capabilities and sanity-checks of ML models. In figure 2 we show exemplary input and the corresponding output, again generated by the network architecture used in [3].

Both videos as .avi files as well as TensorFlow tfrecord files can be accessed via our GitHub repository³. Similar to the Flying Shapes dataset, the tfrecord files contain 10 frames of each original video, again taken equally distributed over their playtime. Technical information can be extracted from the following subsections.

A. Video File Specifications

The .avi video files have the following specifications:

- video resolution: 128×128
- fps: 30
- color depth: 24bpp (3 channels, RGB)
- video codec: ffmpeg
- compression format: mjpeg
- color encoding: yuvj420p

³<https://github.com/ferreiraafabio/PlanarManipulatorDataset>

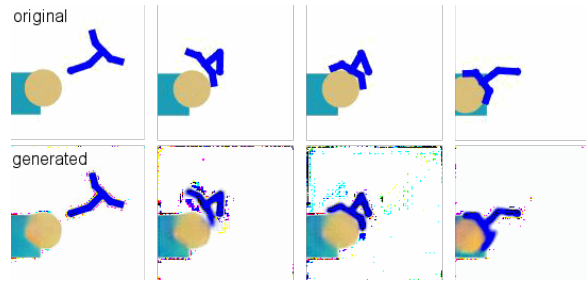


Fig. 2. Simulated Flying Shapes example. Top: original data as publicly provided. Bottom: output generated by a deep auto-encoder which was trained on the Simulated Flying Shapes dataset. A moving example can be obtained from the repository (see attached URL).

B. tfrecord Specifications

The tfrecord files have been created with the pip package `video2tfrecord` and each file contains 1000 videos. For the same reasons as for the Simulated Flying Shapes dataset, every single tfrecord file entry consists of 10 RGB frames which were taken equally distributed over the video playtime. Again the video data is stored in a *feature* dict which is serialized as `tf.train.Example` and contains the following keys:

- `feature['path']`
- `feature['height']`
- `feature['width']`
- `feature['depth']`
- `feature['id']`

In contrast to the Simulated Flying Shapes dataset, the tfrecord meta dict does not have additional information related to the video content.

III. DOWNLOAD

Videos and tfrecords of both datasets are provided as .tar.gz chunk files which can be downloaded in two ways:

- use the download scripts `download_videos.py` or `download_tfrecords.py` provided in the respective repositories and run them with Python to download them directly into the script directory.
- open the `{flyingshapes, planarmanipulator}_videos.txt` file (or `_tfrecords.txt`) provided in the repositories and use the links to directly download the files with a browser.

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