A Zonotopic Dempster-Shafer Approach to the Quantitative Verification of Neural Networks: Repeatability Package

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1 Contents

We present a Julia package, executable through a docker file, to reproduce the results of our approach presented in the paper, namely Table 1 and the DSZ results of Tables 2 and 3 (the 'Probstar' results in Tables 2 and 3 belonging to prior work from the state of the art, are not included in the package).

Dependencies This package builds in particular on:

- the ProbabilityBoundsAnalysis.jl package for p-boxes analysis with Dempster-Shafer interval structures
- the LazySets.jl package for calculus with convex sets
- the NeuralVerification.jl package for neural network verification (used for zonotopic reachability analysis

Contents The `src` sub-directory contains the code of the analysis:

- `Zono_utils.jl` contains a few utility functions for set-based (zonotopic) analysis, relying on functions from the LaySets and NeuralVerification packages
- `DSI.jl` implements the neural network analysis with Interval Dempster-Shafer structures, as described in Section 3 of the paper,
- `PZono.jl` implements the neural network analysis with Probabilistic Zonotopes, as described in Section 4 of the paper,
- `DSZ.jl` implements the neural network analysis with Dempster Shafer Zonotope Structures (DSZ), as described in Section 5 of the paper.

The `examples` sub-directory contains notebooks to reproduce the results of Tables 1, 2 and 3 of the paper.

2 Building and running the Docker image

Retrieve the DSZAnalysis directory and run in this directory the command:

```
docker build . -f Dockerfile
```

An image sha256:... is built, which you can execute by:

```
docker run -it --name FM sha256:...
```

3   Running the examples of the paper

Executing the docker image as described in Section **??** should run Julia. You can now run the examples the paper to reproduce the 3 tables. In the directory `examples` of the package, the examples are provided as notebooks, but they are also converted in the docker image to Julia files.

3.1   Table 1

The results of Table 1 can be reproduced by running the following under Julia:

```
include("ToyExample.jl")
```

The script first reproduces the result with Uniform law on the inputs (first four lines of Table 1), comparing the probability bounds and timings for DSI analys, probabilistic zonotope analysis and DSZ analysis for increasing number of focal elements (2, 10, 100, 1000), corresponding to the four lines.

Then the same is done with Normal law on inputs.

3.2   Table 2

The following reproduces the DSZ results of Table 2.

```
include("ACASXu.jl")
```

3.3   Table 3

The following reproduces the DSZ results of Table 3.

```
include("RocketLander.jl")
```