mdp_CTL_BR Artifacts Abstract

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***Please note that the artifacts were presented in MATLAB code, therefore, MATLAB will be needed for reproducing these artifacts.** This document is submitted along with the artifact for the evaluation of the algorithm presented in the paper *"CTL Model Checking of Markov Decision Processes over the Distribution Space"*.

This artifact contains the tools and codes that will be used to reproduce the results of Example 2 and Section 5 in the paper. Due to the demanding computation to perform reachability in Section 5, we further include the data obtained from the numerical simulation on our platform.

In order to reproduce the results of the paper,

1. run *startup.m* in the *tbxmanager* folder to install the tools (i.e., MPT, Yalmip, and Sedumi) that will be used;
2. run *main.m* in the *3statesMDP-Casestudy1* folder to reproduce the results of Example 2 in the paper. Figures 2–5 are reported in the subfigures of Fig. 4 in the paper and Figure 6 are reported in Fig. 5 in the paper;
3. run *uav_determin_synthesis_plot.m* in the *UAV-Casestudy2* folder to reproduce Fig. 6; run *uav_noisy_synthesis_plot.m* in the *UAV-Casestudy2* folder to reproduce Fig. 7.

We remark that Sedumi solver used in the current artifact can be replaced by Mosek solver. Both solvers can be used to solve the quadratic optimization problems in Algorithm 1 of the paper. It should be highlighted that such replacement does not affect the results of the codes except the computation time, since Mosek is a commercial optimization solver and enables faster computation. The reason of using Sedumi solver in the artifact is to avoid the license issue from Mosek.

We find that it would be slow to run *uav_determin.m* and *uav_noisy.m* (both of which rely on the Sedumi solver in the current artifact) in the *UAV-Casestudy2* folder for computing the distributional backward reachable sets in

Section 5. To facilitate the reviewer to evaluate the computation time reported at the end of Section 5, we put the data in the *Data-Casestudy2* folder that was obtained from using Mosek to run *uav_determin.m* and *uav_noisy.m* on an ARM system M1 chip on MacBook Pro 2021, with 16GB RAM.

1. For the deterministic scenario, open *uav_determin_100runs.mat*. The variable *Com_time* reports the compuation time of 100 independent runs and the variable *Vert_BRexist_union* reports the distributional backward reachable sets with respect to the existential quantifier.

2. For the noisy scenario, open *uav_noisy_100runs.mat*. The variable *Com_time* reports the compuation time of 100 independent runs and the variable *Vert_BRexist_union* reports the distributional backward reachable sets with respect to the existential quantifier.