Hybrid Games

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Verification problems for hybrid systems can be classified on the model of hybrid automata. In particular, linear-time specifications can be verified on rectangular hybrid automata, which induce finite language quotients; universal branching-time specifications can be verified on 2D rectangular automata, which induce finite similarity quotients; and all branching-time specifications can be verified on singular automata, which induce finite bisimilarity quotients. (For nonrectangular automata, even invariance is undecidable.)

We offer a similar classification of control problems for hybrid systems. For this purpose, we extend the model of hybrid automata, which can be viewed as single-player structures, to hybrid games, which are two-player structures (plant vs. controller). We show that for linear-time objectives on rectangular games, the winning states for each player can be computed and winning strategies can be synthesized. This is because all rectangular games induce finite alternating-language quotients. Furthermore, in analogy to the one-player case, additional game properties can be computed for 2D rectangular games, which induce finite alternating-similarity quotients, and on singular games, which induce finite alternating-bisimilarity quotients. These additional properties can be expressed in the game logic ATL (alternating-time temporal logic).

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