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Application of Directed Relational Graphs to Air Plasma Chemistry During Plasma Relaxation[1] SAMANTHA PHILLIPS, William Mary College, LUKE ALAN JOHNSON, GEORGE M. PETROV, PAUL BERNHARDT, DANIEL F. GORDON, Naval Research Laboratory — Air plasma chemistry is important to many physical processes such as atmospheric re-entry vehicle generated plasma and electrical discharges. Models of air plasmas often include both hydrodynamic processes and chemical reactions. Large chemical reaction sets can provide necessary details, at the expense of complexity and leading to increased computational costs in multi-dimensional simulations. We adapted a method to create a reduced set of chemical species and reactions to explore hydrodynamics and chemistry of air plasma, while preserving the relevant physics, using a directed relational graph. The method was applied to two test cases: plasma created at high altitudes by re-entry vehicles and air plasma generated by a short pulse laser. In the re-entry vehicle test case, the full set of 54 species and 1010 reactions for air was reduced to only 11 species and 90 reactions, while achieving less than 1% error in electron densities. For laser-generated plasma at atmospheric pressure, a set containing 20 species and 422 reactions was sufficient. The test cases demonstrate that the directed relational graph method can reduce the chemical species and reactions, thus streamlining computations in multiple dimensions.

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