

Approximate Algorithm

An improvement on the original

- Serial version is algorithm used in DGGML.
- Key additions:
 - Match data structure
 - Incremental update
 - Synchronization
 - Rule recomputation
- Has potential to be scaled to large problems.

Improved Approximate Spatially Embedded Hybrid Parameterized SSA/ODE Algorithm

```
initialize the match data structure with all rule instances;
while  $t_{global} \leq t_{max}$  do
  foreach dimension  $d \in \{D_{max}, D_{max} - 1, \dots, 0\}$  do
    using function  $\varphi$  map rule instances to the geocells of the expanded cell
    complex;
    ParFor expanded geocell  $c_i \in ExpandedCellComplex(d)$  do
       $t_{local} = t_{global}$ ;
      factor  $\rho_r([x_p], [y_q]) = \rho_r([x_p]) * P([y_q] | [x_p])$ ;
      while  $t_{local} \leq t_{global} + \Delta t_{local}$  do
        initialize SSA propensities as  $\rho_r([x_p])$ ;
        initialize  $\rho^{(total)} := \sum_r \rho_r([x_p])$ ;
        initialize  $\tau := 0$ ;
        draw effective waiting time  $\tau_{max}$  from  $\exp(-\tau_{max})$ ;
        while  $\tau < \tau_{max}$  and  $t_{local} \leq t_{global} + \Delta t_{local}$  do
          solve ODE system, plus an extra ODE updating  $\tau$ ;
           $\frac{d\tau}{dt_{local}} = \rho^{(total)}(t_{local})$ ;
          draw rule instance  $r$  from distribution  $\rho_r([x_p]) / \rho^{(total)}$ ;
          draw  $[y_q]$  from  $P([y_q] | [x_p])$  and execute rule instance  $r$ ;
          incrementally update match data structure;
        synchronize and remove invalid rule instances from data structure of matches;
      recompute rule level matches (as needed);
     $t += \Delta t_{global}$ ;
```

Algorithm 3

The DGG Modeling Library