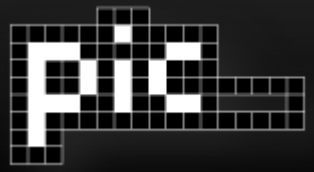

Catarina Runa – PIC Weekly Presentations
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GRAPH-BASED FIRE SYNTHESIS

Yubo Zhang, Carlos D. Correa, and Kwan-Liu Ma

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SCOPE

Novel graph-based data-driven technique for cost-effective fire modeling.

MOTIVATION

- Realistic fluids animation, i.e. physically-based simulations, are obtained by solving the Naiver-Stokes equations → High computational cost!
- Accelation techniques of Realistic fluids simulation like adaptative grids and parallelization are effective but are bring complicated technical issues in implementation.

Motion-graph data-driven animation

This data-driven method is relatively easy to implement for synthetizing fire animations at a much lower computational cost.

RELATED WORK

- Physically-based fluid animation – Navier-Stokes solutions and accelation techniques;
- Special effects created introducing artificially synthesized details - due to the complexity and high computational cost of physically accurare high resolution models.

- Limitations of Alternative methods: Data – Driven Approaches
  - Fixed view and cannot be further manipulated;
  - High storage cost;
  - Require high resolution time-varying volume data.

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- Low cost synthesis $\rightarrow$ reduces the lenght of time consuming simulation towards the generation of visually similar results;

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- New fire animations synthesized through a random walk in the flow graph;
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- Cost of simulation grows nonlinearly with the problem scale while the cost of synthesis grows linearly;
- Low cost synthesis which reduces the lenght of time consuming simulation towards the generation of visually similar results;
- Smooth and visually plausible transitions;

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- Generate a directed graph based on Pathlines created by flow tracking of particles over time;
- New fire animations synthesized through a random walk in the flow graph;
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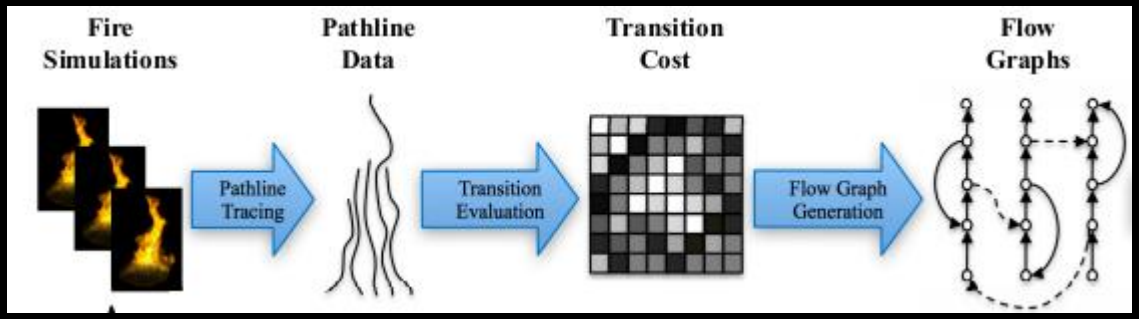
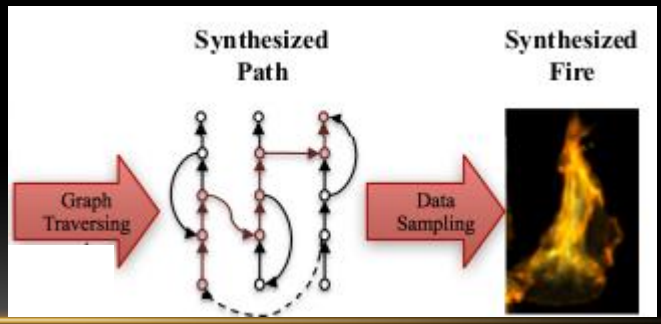
- Cost of simulation grows nonlinearly with the problem scale while the cost of synthesis grows linearly;
- Low cost synthesis which reduces the lenght of time consuming simulation towards the generation of visually similar results;
- Smooth and visually plausible transitions;
- Quality of transitions depend of the original data.

PIPELINE

- Divided in two steps:
  - 1) Flow Graph Construction



  - 2) Interactive Fire Synthesis

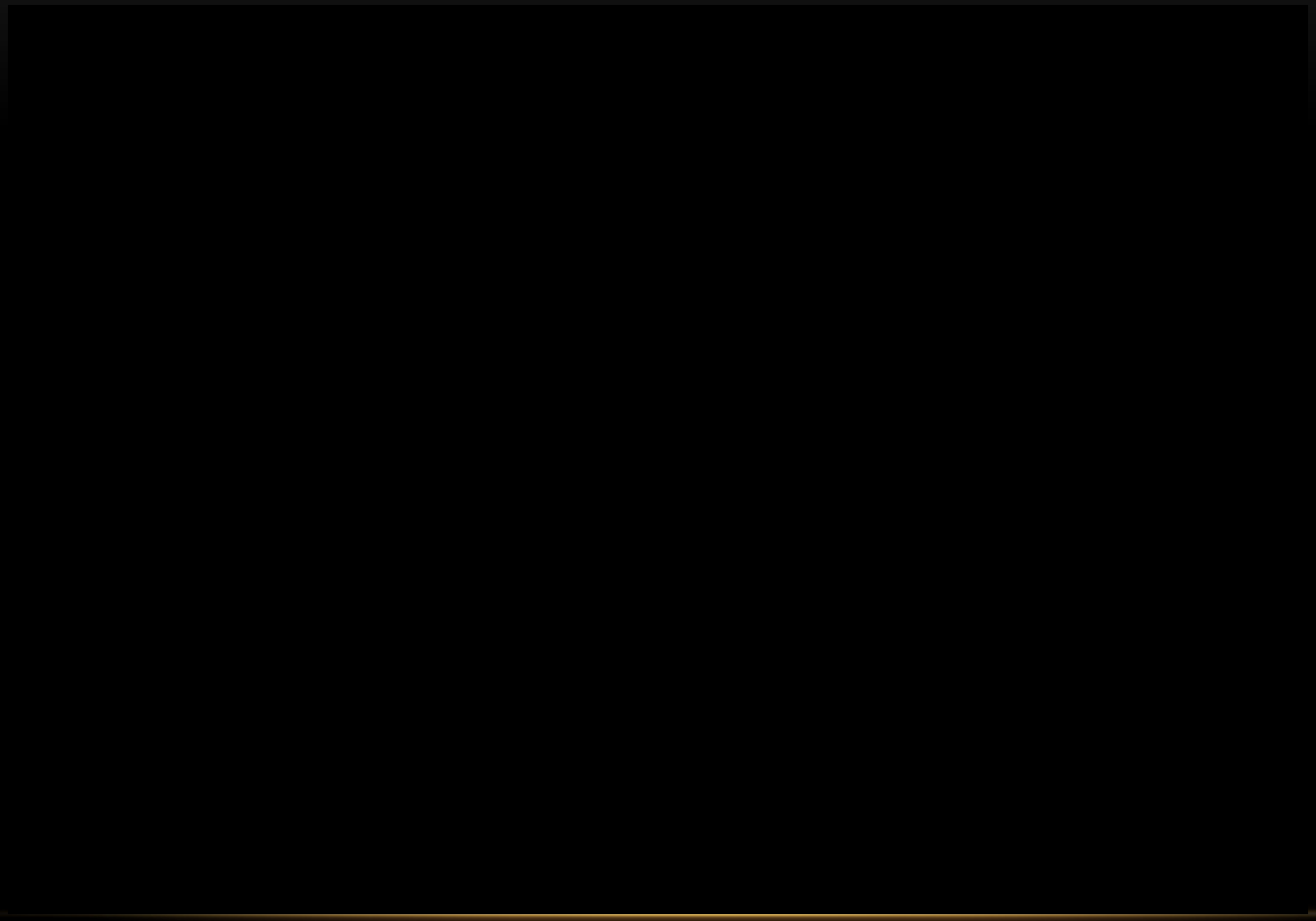


ALGORITHM

Algorithm 1 Graph-based Fire Synthesis

```
Load configuration
Load flow graphs
Allocate particle buffers
Start streaming pathline data
while synthesizing = true
    Read user state constraint of flow graph
    Let node be next random node under constraint
    Emit particles associated with node
    Update positions of existing particles
    Sample particle attributes from pathline data
    Remove particles which exceed lifetime
    Send current particles to the preview renderer
end
```

RESULTS



CONCLUSIONS

- Lower storage and computational cost.
- Synthesized particle results offer better interactivity than volumes for operations like external deformations;
- Reduced simulation time;
- Modular technique;
- Can be extended to other dissipative gaseous effects.

LIMITATIONS

- It cannot physically accurate fluid-fluid/fluid-solid interaction without addicional simulations during the synthesis process;
- It do not allow motion blending to prevent breaking important flow structures (i.e. vortices);
- Requires that fire emanates from a source region and dissipates in a limited time.

QUESTIONS =)