Visualizing Local Properties and Characteristic Structures within Dynamical Systems

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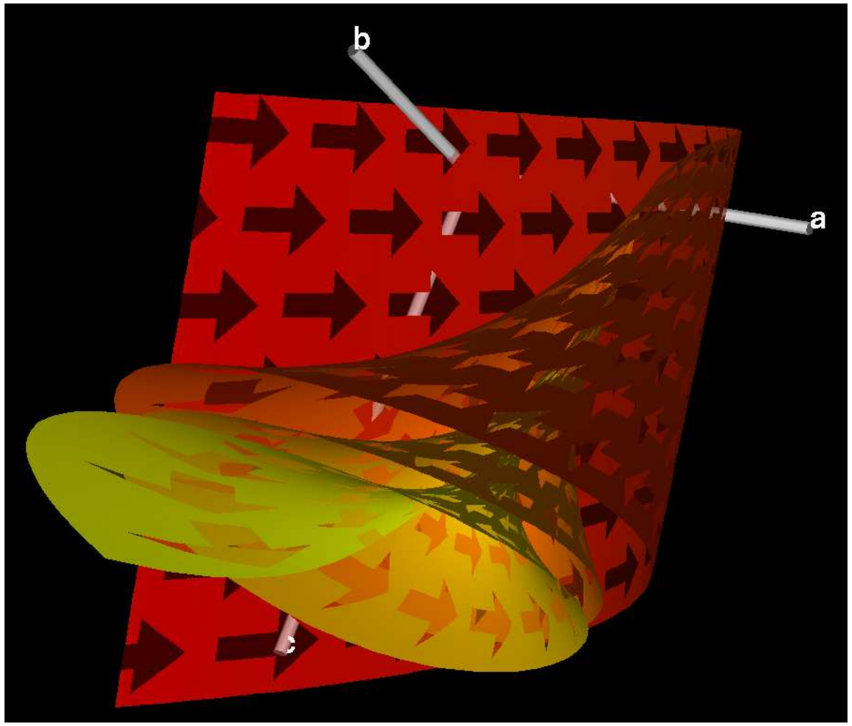
Visualizing Dynamical Systems – Runways

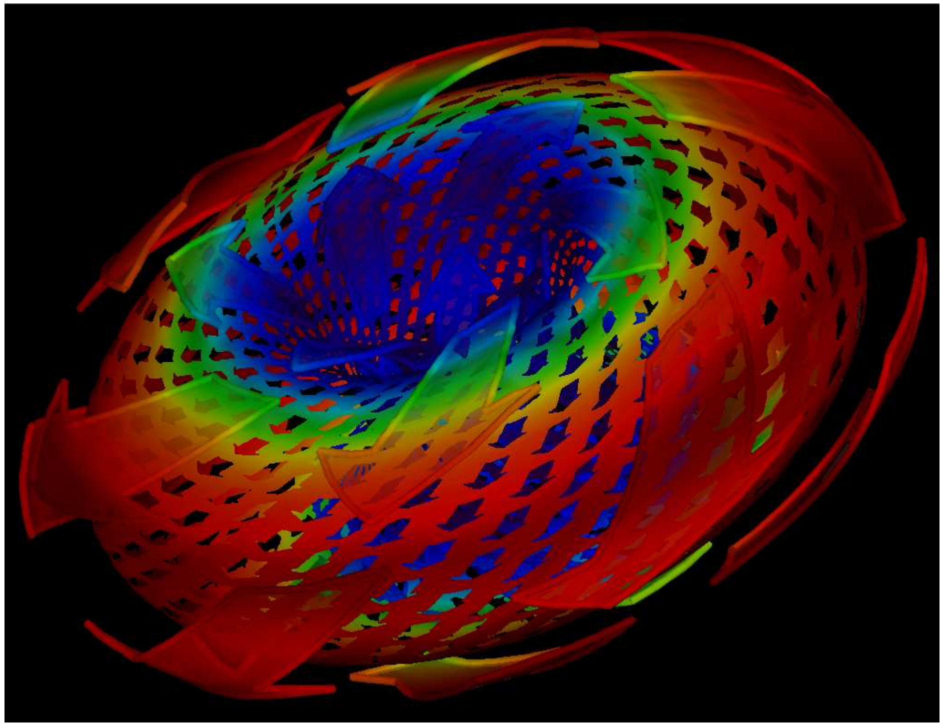
Visualizing classes of dynamical systems (bifurcation diagrams)	(characteristic elements vs. a parameter)
fixed parameters: ↓	**Visualizing system abstractions**
Visualizing one specific dynamical system (hedgehog plots, spot noise, LIC, stream surfaces, stream lines, VolViz of 3D dynamical systems)	(fixed points, separatrices)
local investigation: ↓	
Visualizing a specific region of interest (fixed point viz, glyphs)	(eigenvectors, eigenvalues)

Four Approaches – Overview

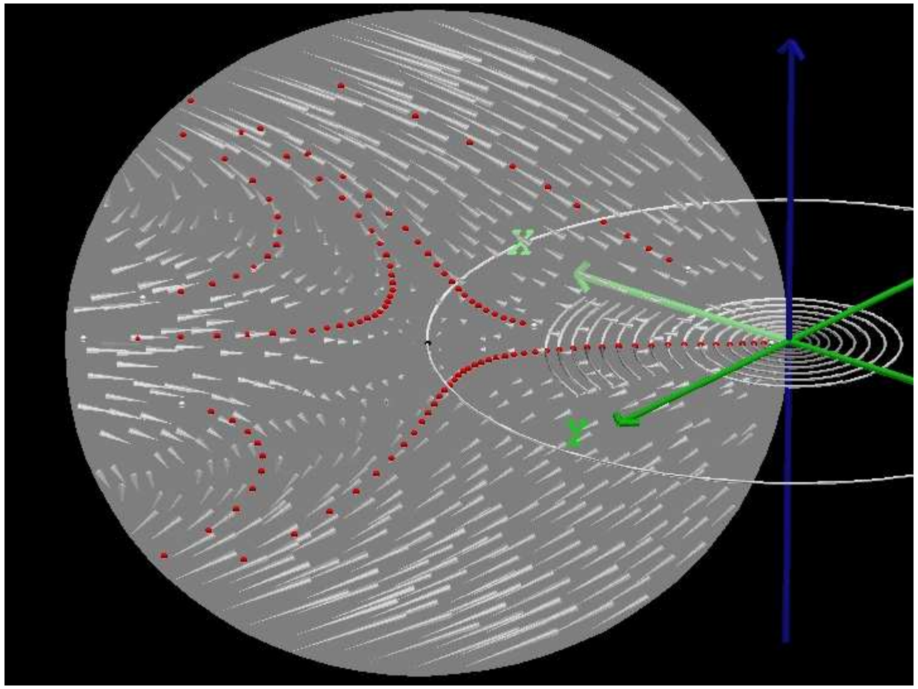
- **Streamarrows and Hierarchical Streamarrows –**
  enhancing stream surfaces
- **Poincaré Section Visualization –**
  integrating 2D Poincaré map visualization and 3D techniques
- **Fixed Point Visualization –**
  visualizing the Jacobian matrix together with stream lines
- **Visualization using Threads of Stream lines –**
  enhancing an abstraction by direct visualization

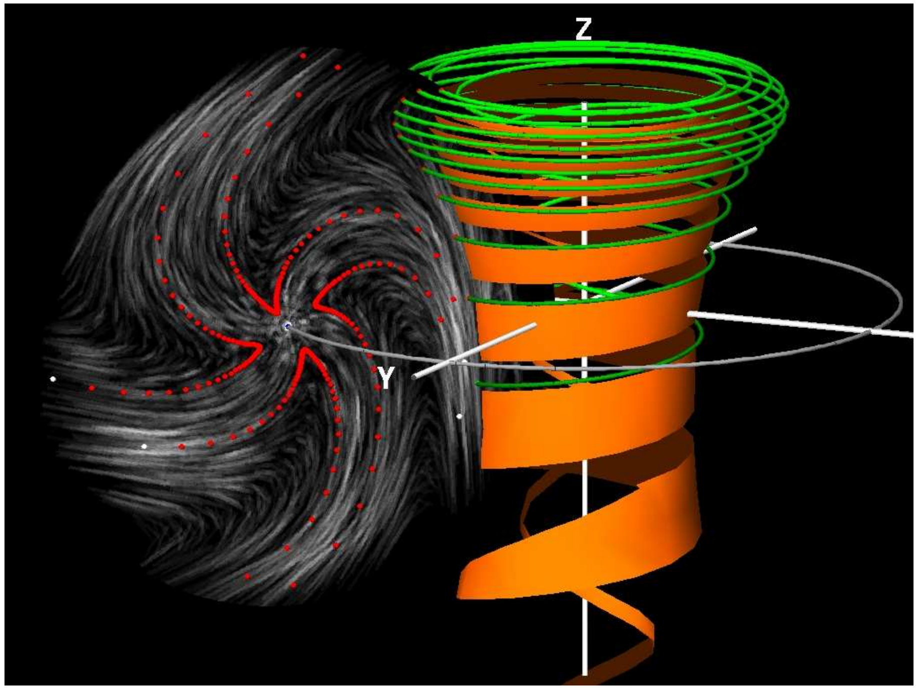
Streamarrows and Hierarchical Streamarrows





Poincaré Section Visualization





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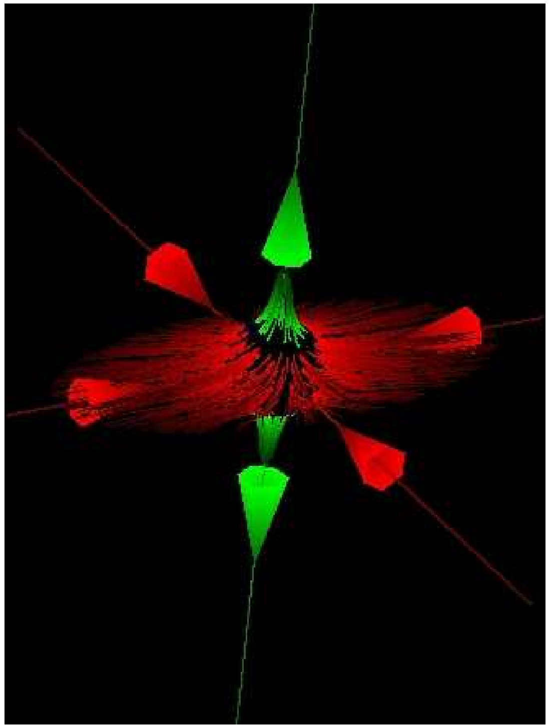
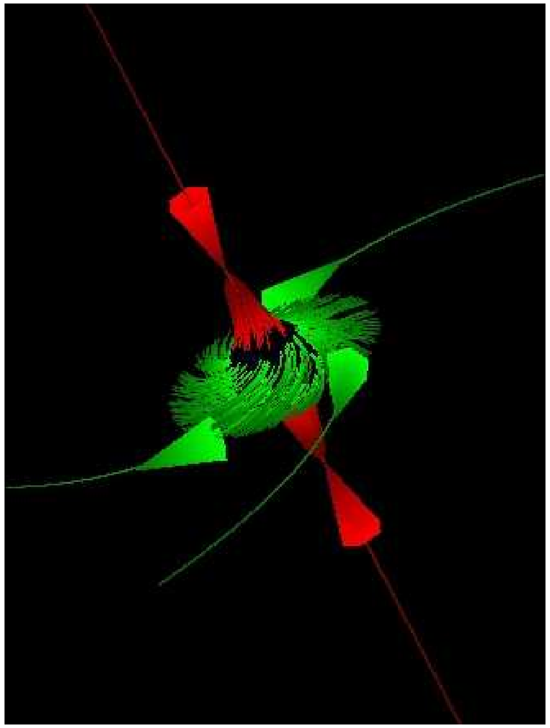
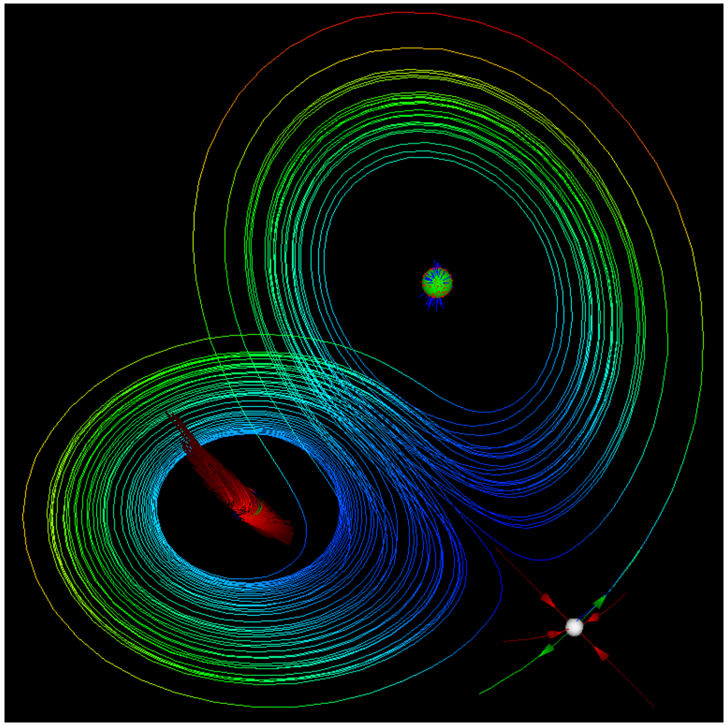
Fixed Point Visualization

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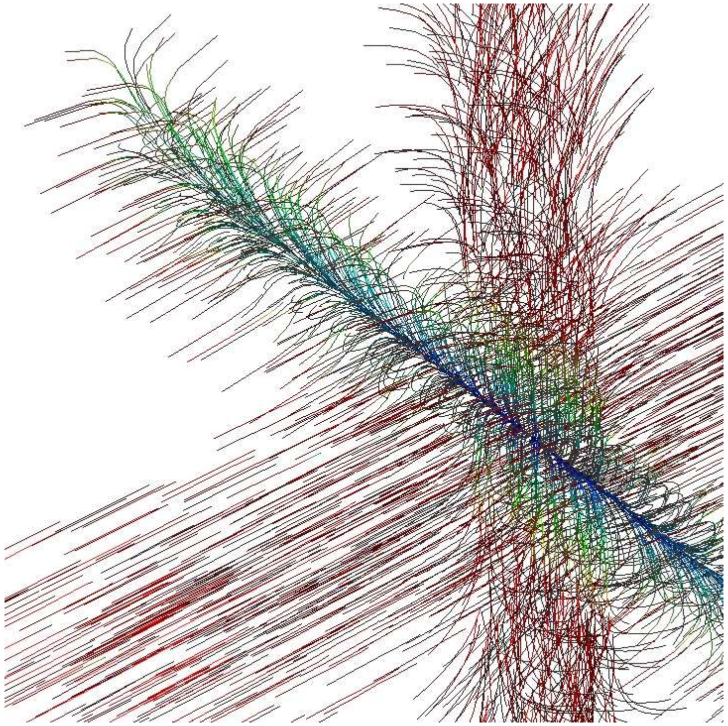
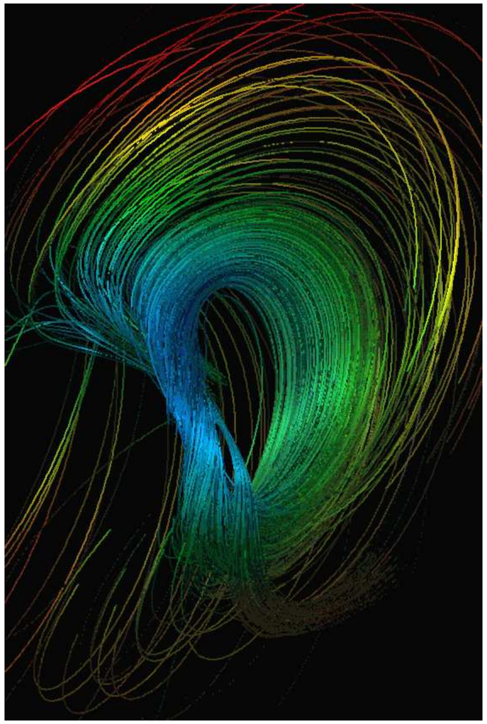
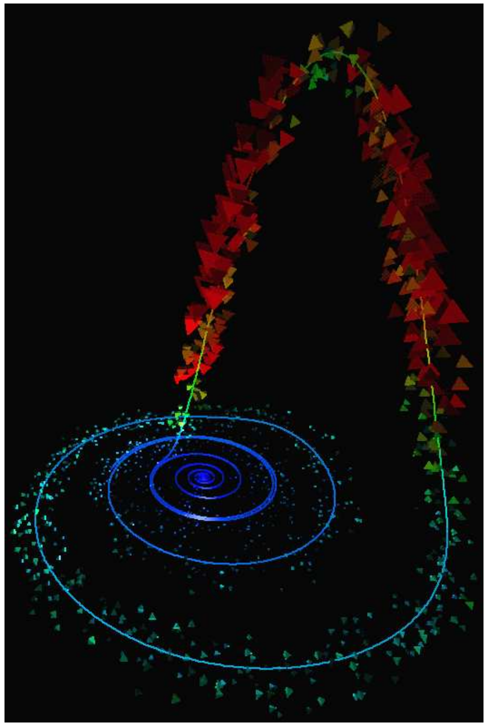
Visualization of Characteristic Trajectories







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Conclusions

- **Local investigation and visualization –**
  especially useful at points of degeneracies, e.g., fixed points

- **System abstractions –**
  useful for the experienced researcher, usually extremely dense information.

- **Conclusions –**
  Use local visualization and the visualization of system abstractions in combination with direct visualization.

URL `http://www.cg.tuwien.ac.at/research/vis/dynsys/`