

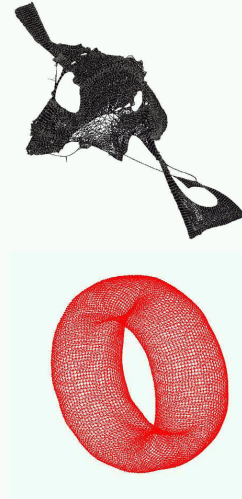
TopoLayout: Layout of Graphs by Topological Feature

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Multilevel Approaches

most approaches only work on some graphs



[GRIP: www.cs.arizona.edu/~kobourov/GRIP/torus.jpg]
[FM3: www.informatik.uni-koeln.de/ls_ljuenger/people/hachul/diss_hachul.pdf]

Graph Drawing Criteria

minimize

- crossings, area, bends/curves

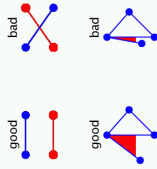
maximize

- angular resolution, symmetry

most criteria individually NP-hard

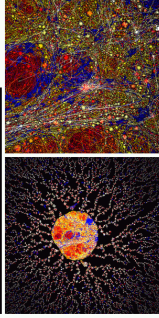
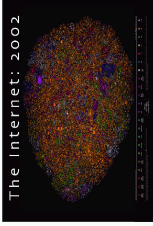
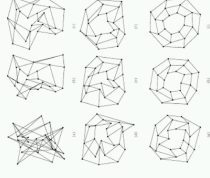
- cannot just compute optimal answer
- heuristics: try to find something reasonable

criteria mutually incompatible



[Ware, Purchase, Colpus, and McGill: Cognitive Measures of Graph Aesthetics. Information Visualization 1(2):103-110, Palgrave 2002].
[Bauer and Goetz: Graph Drawing: Algorithms and Software, Springer 1997].
[Visualization in Human-Computer Interaction, Springer (Verlag) 1988]

Force-directed Placement



[www.csse.monash.edu.au/~berndm/CS460/lectures/cs460-7.pdf]
[Lumeta/Ches: research.lumeta.com/ches/map][LCL: braininformatics.cmb.utexas.edu/l9/]

Topological Multilevel Decomposition



recursively chop up by feature

- detectors

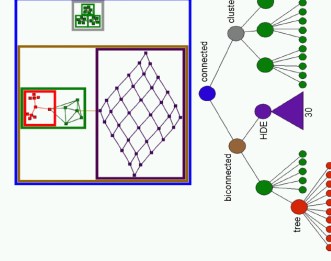
construct hierarchy

- entire subgraph collapsed into single node at higher level

lay out piece using appropriate algorithms

fix it up: torques, overlaps

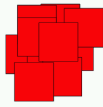
Subgraph Hierarchy



Topology Detection Order

- connected
- trees
- biconnected
- HDE
- cluster
- unknown

Area-Aware FDP



tweaking GEM

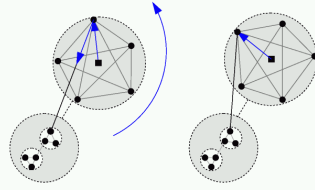
$$f_{\text{repulsive}}(n_i, n_j) = \frac{t + \lceil r_i + r_j \rceil}{\|p_i - p_j\|^2} (r_i - r_j)$$

$$f_{\text{attractive}}(n_i, n_j) = \frac{\|p_i - p_j\|^2}{t + \lceil r_i + r_j \rceil} (r_j - r_i)$$

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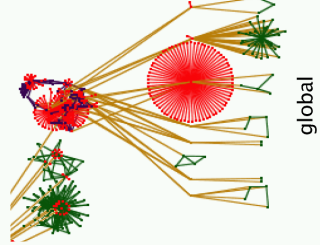
Minimizing Crossings

edge/edge or edge/node
inspired by torques



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Eliminate Overlaps



global

per-subgraph₉

Results

	ACE	HDE	GRIP	FM*	TopoLayout
10056 8330	0.84	0.84	4.30	21.26	7.20
647 6330	1.00	0.37	1.78	16.62	0.87
snowflake 8700	0.7	0.50	3.66	16.86	0.93

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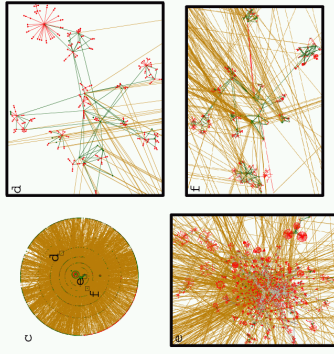
Results

	ACE	HDE	GRIP	FM*	TopoLayout
Snake 5000	15.18	0.64	5.34	15.97	1412.09
flower 18250	0.32	0.92	9.37	11.30	88.15
flowers 18250	649.73	17.69	(E)	399.43	10.20

Results

	ACE	HDE	GRIP	FM*	TopoLayout
1004 1178	0.16	0.03	0.21	0.74	0.81
10032 9462	1.00	0.35	1.52	11.37	14.62
10044 10264	84.46	6.66	(E)	153.54	56.07

NonResults: Feature Set Insufficient



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Challenges

- information density
- intractable core
- quasi-features
- application-specific features