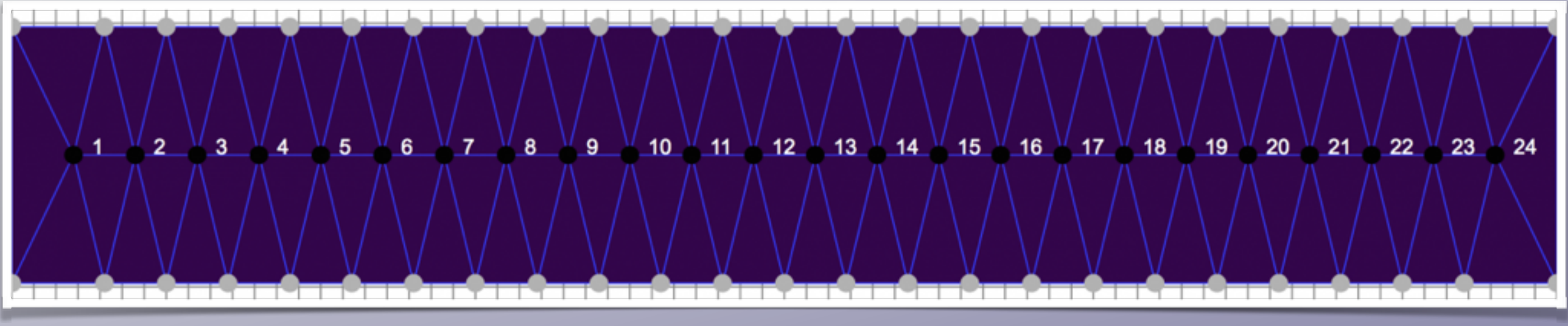
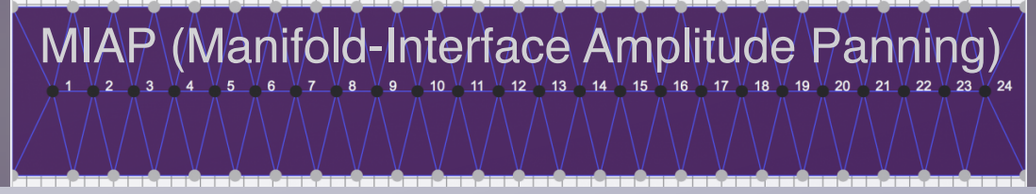


MIAP: Manifold-Interface Amplitude Panning in Max/MSP and Pure Data

Zachary Seldess
Senior Audio Research Engineer
Sonic Arts R&D, Qualcomm Institute
University of California, San Diego
zseldess@gmail.com

MIAP website: http://www.zacharyseldess.com/miap



1986: Canberra, Australia

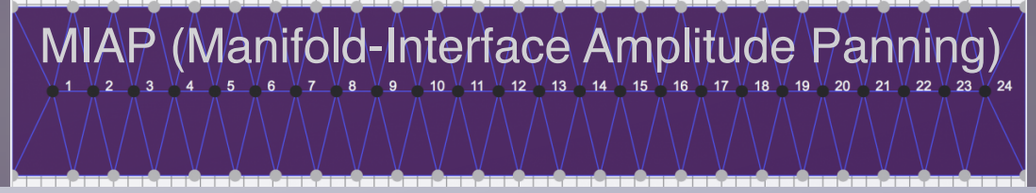
- Steve Ellison began work on a real-time computer music composition system for a polymedia performance space by *“Floating Exceptions”.*

  http://worrall.avatar.com.au/pipes/

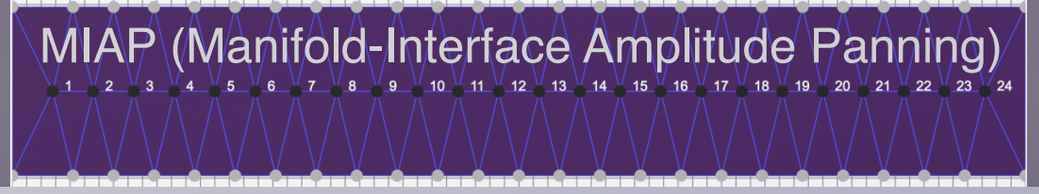
Dr. David Worrall, director

polymedia dome

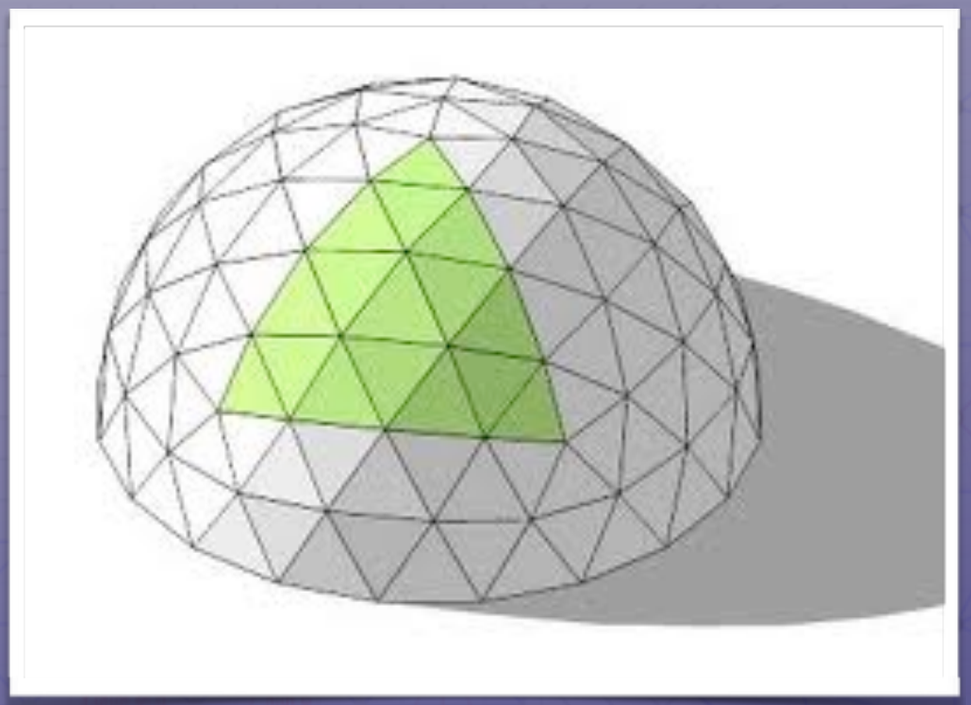
MIAP (Manifold-Interface Amplitude Panning)

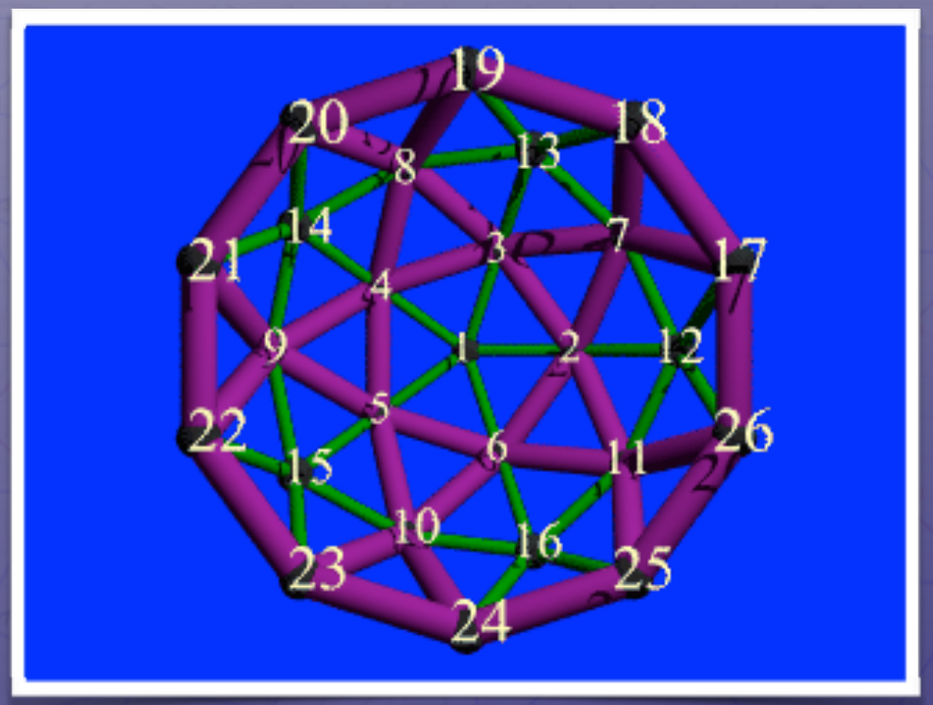


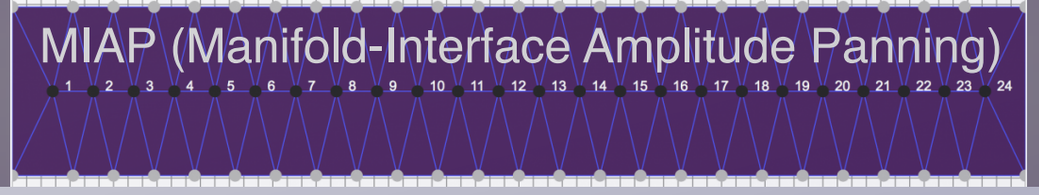
- Ellison needed a computationally efficient method to compute gains for loudspeakers placed at vertices of dome.



- Ellison needed a computationally efficient method to compute gains for loudspeakers placed at vertices of dome.
- Influenced by triangular speaker configuration, he invented a novel amplitude panning algorithm using barycentric coordinates to derive power-preserving speaker gains for loudspeaker triplets.

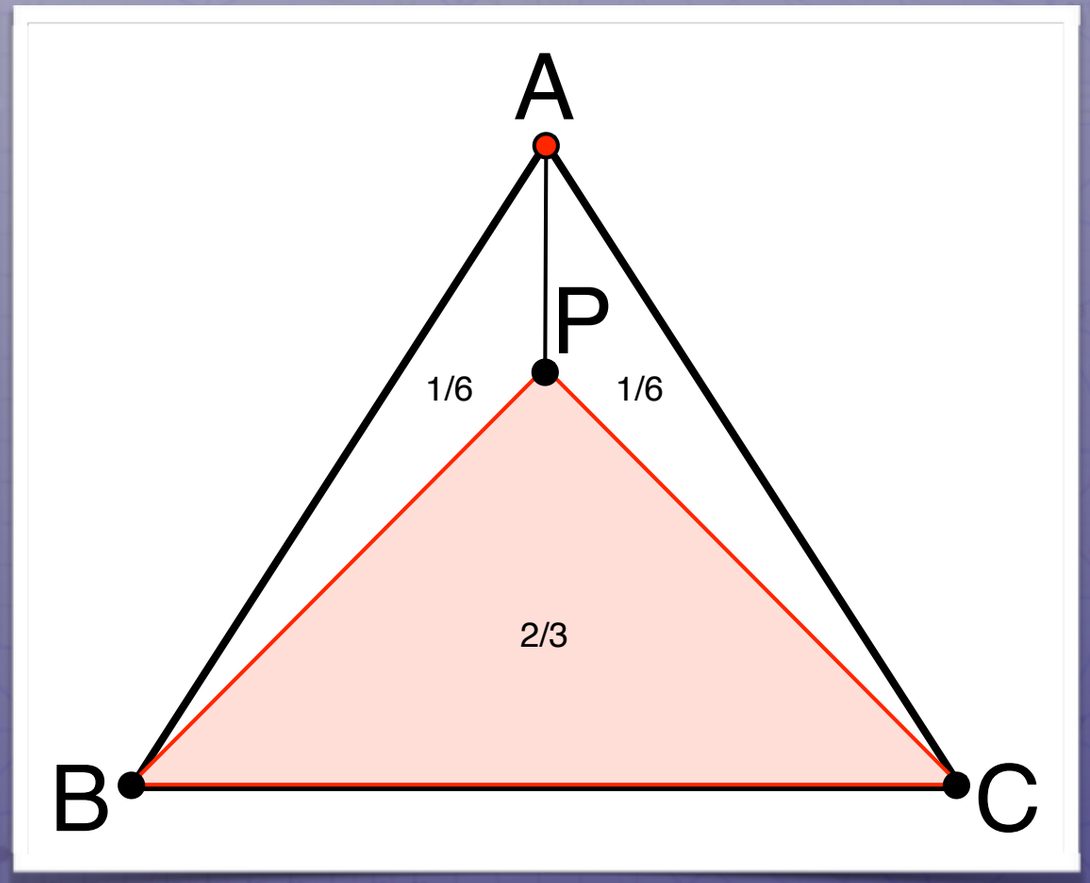






Barycentric Triset Panning:

1. Normalize the areas of all sub-triangles.
2. Apply the square root of each normalized sub-triangle area as a gain value to the node of the parent triangle not included in that sub-triangle.

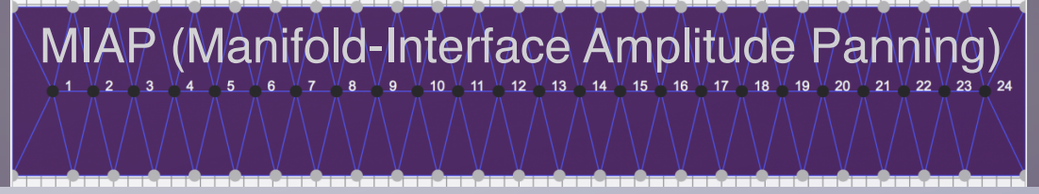


<u>gains per node:</u>

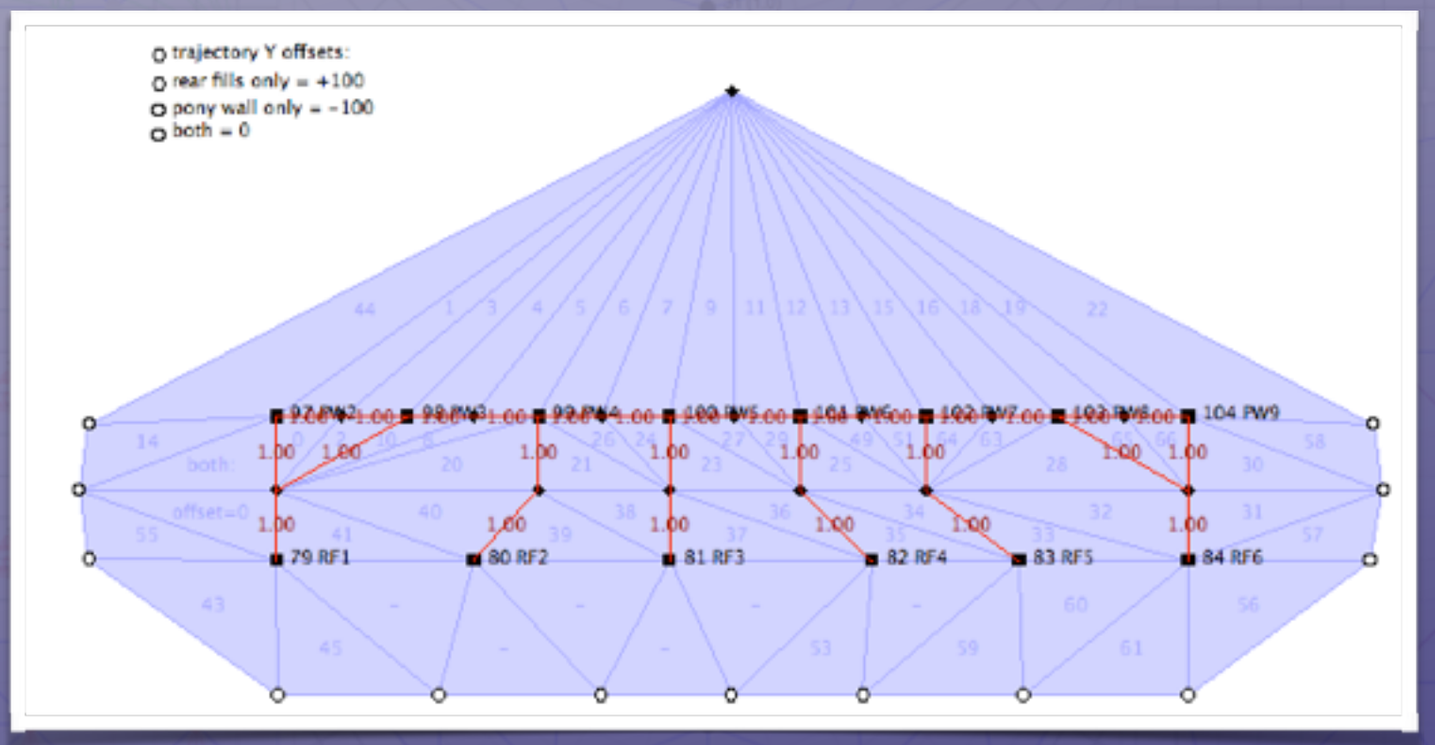
A = √(2/3) = 0.8165

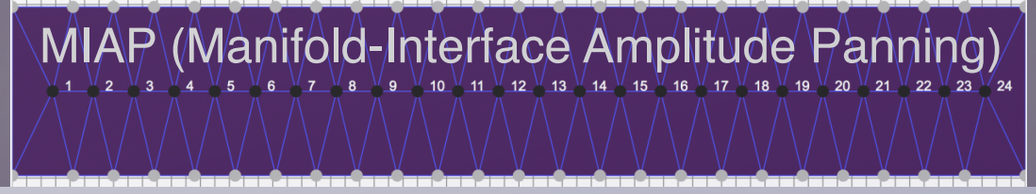
B = √(1/6) = 0.4082

C = √(1/6) = 0.4082

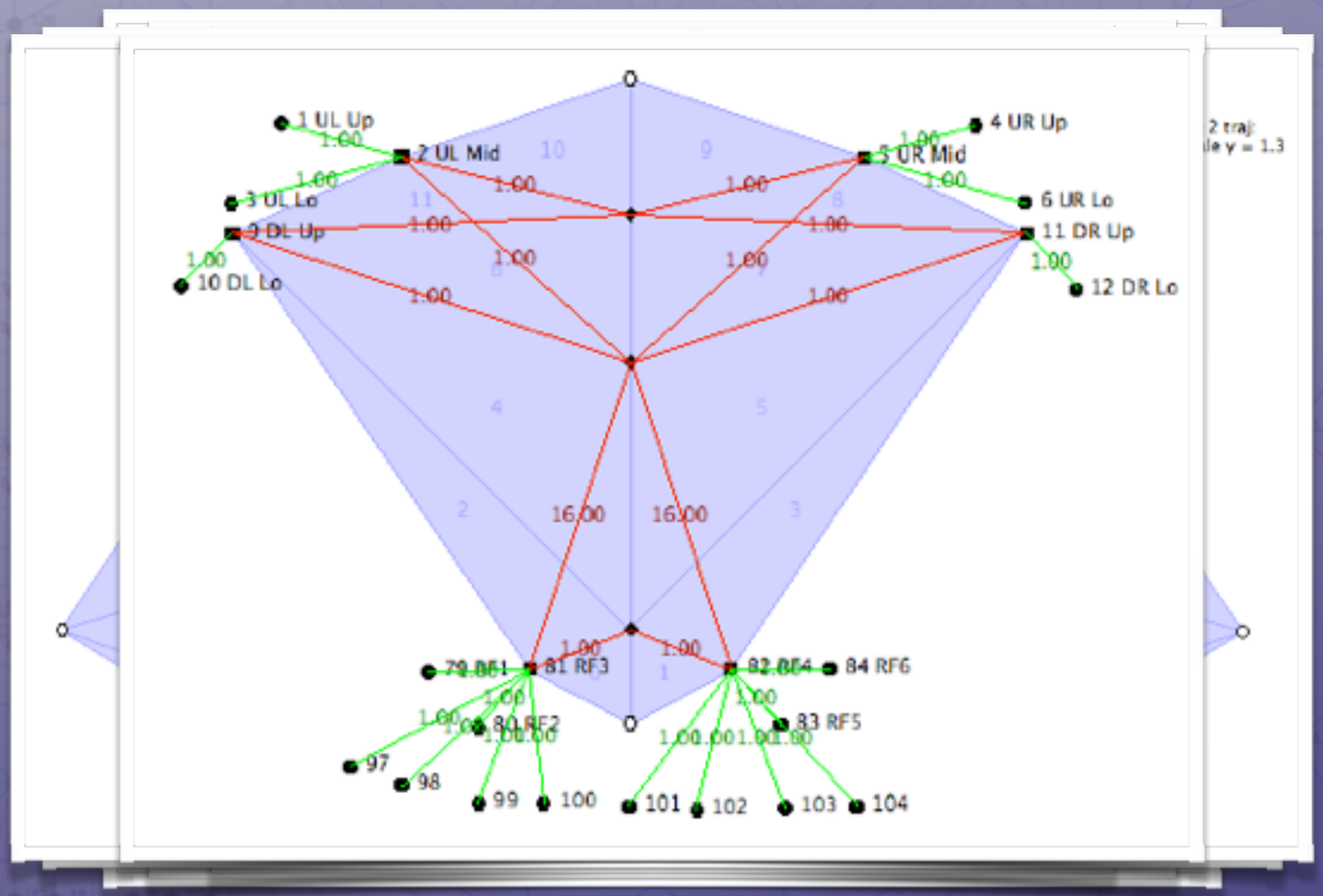


- Software implementation of algorithm originally called "SpaceNodes", later renamed “SpaceMap(R)".
- First commercial iteration in the early 1990s.





- Authoring, control constructs, and GUI underwent several practically-driven improvements over next two decades.
- Used by a generation of sound designers working in large-scale spectacle shows such as Cirque Du Soleil, Disney Theme Parks Exhibits, etc.



Historical Significance:

- Essentially unknown outside of theatrical sound design community

SOUND DIFFUSION TIMELINE

potentiometre de space	1951s	early history
Osaka World Fair		
GRM Acousmonium	1970s	
Gmebaphone		the age of the speaker orchestra
SpaceMap Ambisonics		
BEAST	1980s	
Higher Order Ambisonics		
Vector Base Amplitude Panning	1990s	technical spatialisation algorithm development
Wave Field Synthesis		
Cybernephone		
GSMAX		
M2		
Hand Held Light Tracking Devices	2000s	
Gesture Trackers		new wave of diffusion techniques
Resound		
The Allosphere		
SARC Sonic Lab		
Sound Scape Renderer		
Grainstick	2010s	rapid development of new interfaces for diffusion performance
tactile.space		
Chronus		
Sound Scape Renderer For Android		
Centour (Kinect)		
tactile.motion		
Chronus_2.0		

Historical Significance:

- Only scholarly mention of Ellison's barycentric panning is found in a single sentence of Ville Pulkki's 2001 dissertation on Vector-base amplitude panning.

SOUND DIFFUSION TIMELINE

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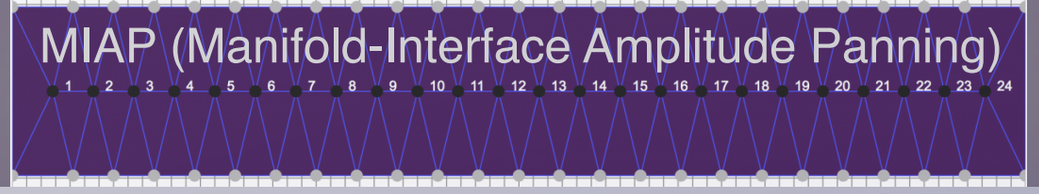
Chronus		
Sound Scape Renderer For Android		
Centour (Kinect)		
tactile.motion		
Chronus_2.0		

Historical Significance:

- Fascinating example of a stable, codified tool for spatial sound design developed entirely out of practical necessities… as opposed to more academic notions of "what would be ideal".
- The only example of its kind? (Tell me if you know of another)

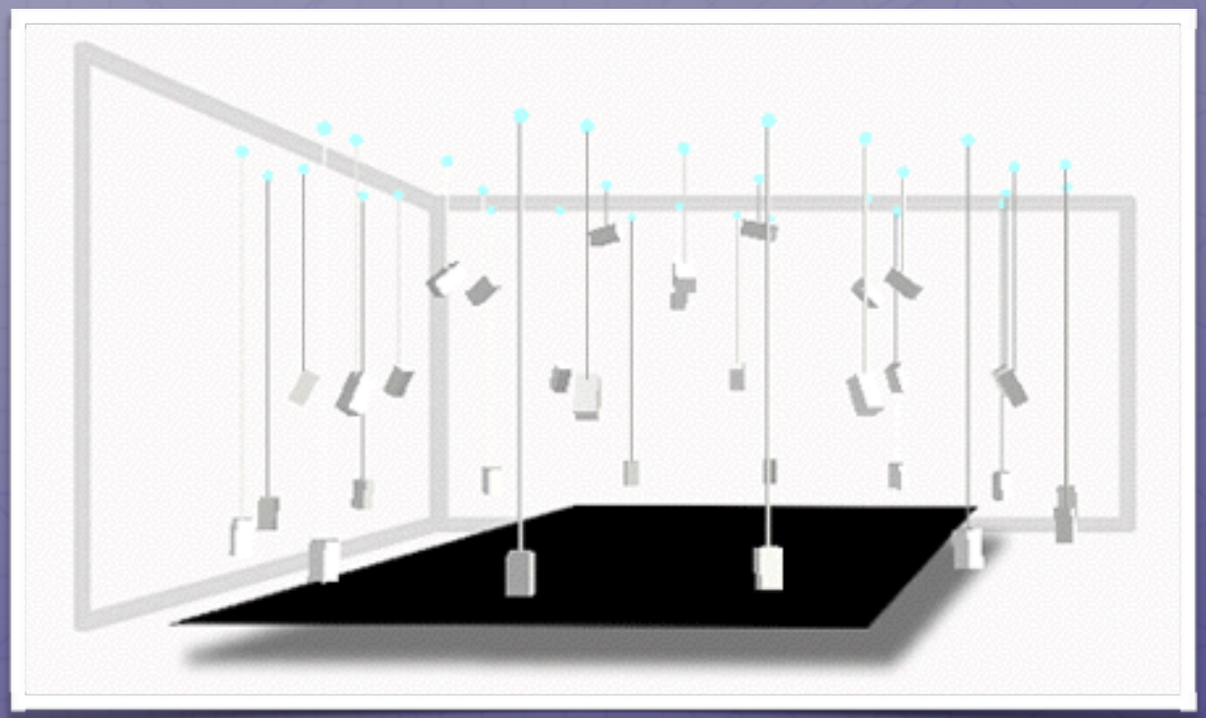


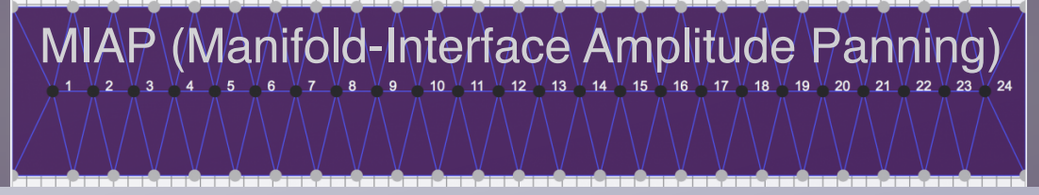
Practical / Artistic Significance:

“Centric” Model:

- Sound spatialization approaches, such as Vector-base amplitude panning and Ambisonics, treat the authoring of spatial sound essentially as an act of augmenting the aural environment of an idealized listening area, or “sweet-spot”.

ZKM Klangdom





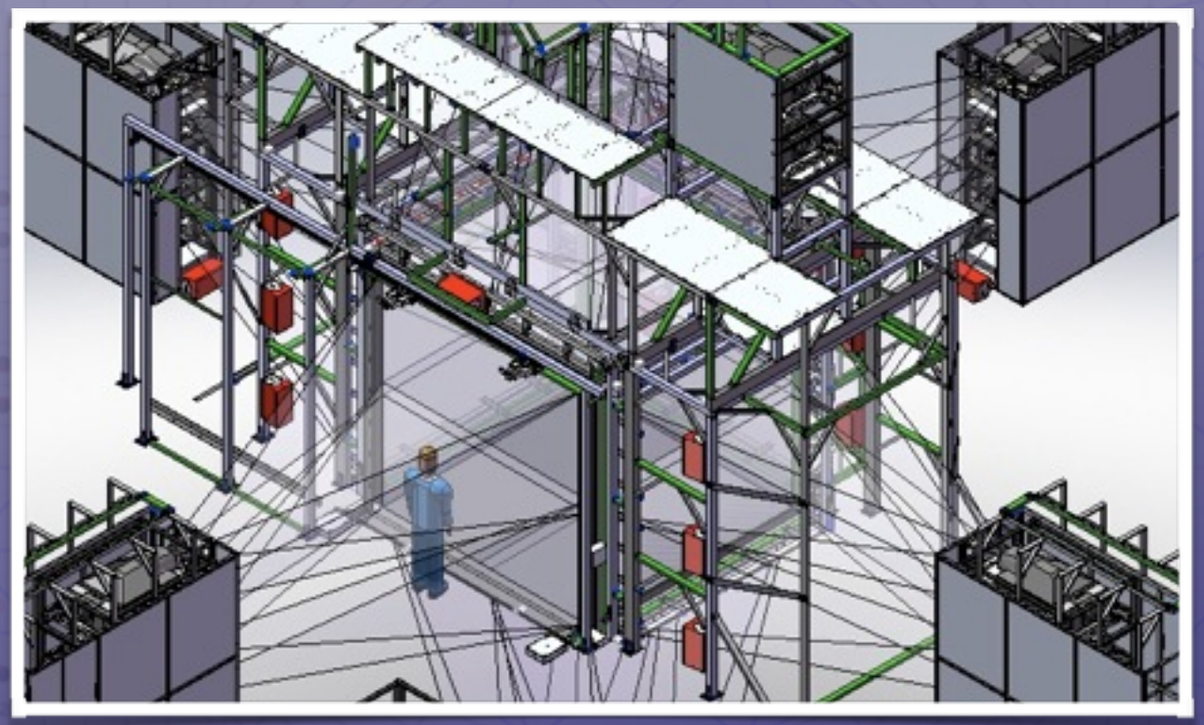
Practical / Artistic Significance:

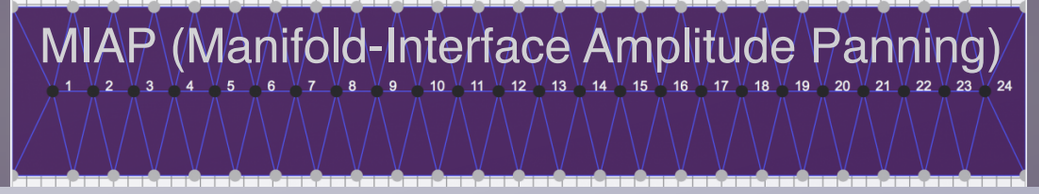
“Centric” Model:

- Model works for wide range of use-cases.

- Provides a vehicle for authoring sound without requiring that the author consider the mechanisms by which the sound will be realized.

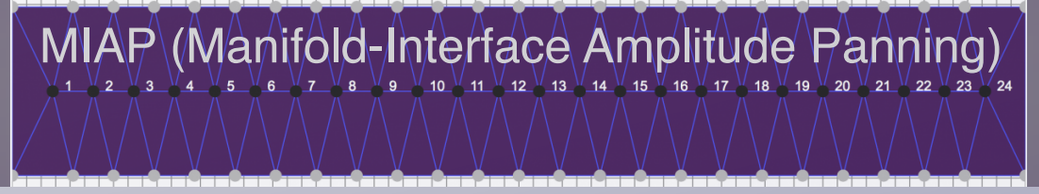
KAUST “Cornea” 20.4ch VR CAVE





Assumptions of the “Centric” Model:

1. Loudspeakers must be equidistant from the assumed listening area.
   - (possibly remedied via delays, attenuation, and/or EQ)



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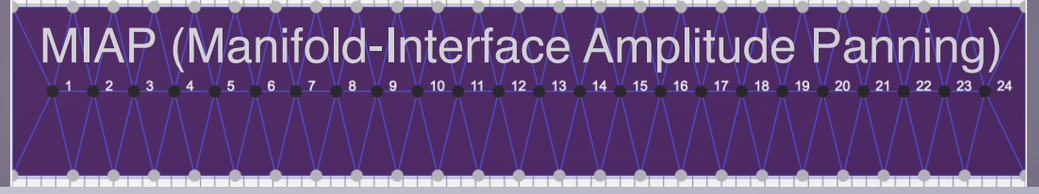
2. Loudspeakers must be angled in towards a converging listener “sweet-spot”.



Assumptions of the “Centric” Model:

1. Loudspeakers must be equidistant from the assumed listening area.
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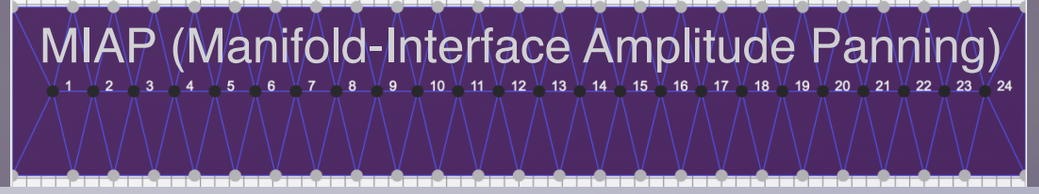
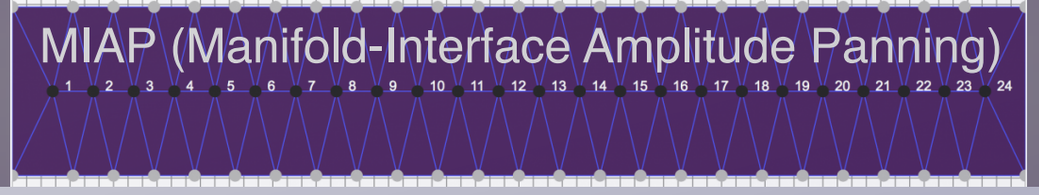
2. Loudspeakers must be angled in towards a converging listener “sweet-spot”.

   - These constraints may be in conflict with realities of many loudspeaker setups, such as can be found in the realms of site-specific sound art installation, and large-scale theatrical sound spectacle.



Non-Centricity in SpaceMap:

- How to foreground the rendering mechanisms of given setup without anchoring the language of the tool on a listener origin (i.e. “sweet spot”)?



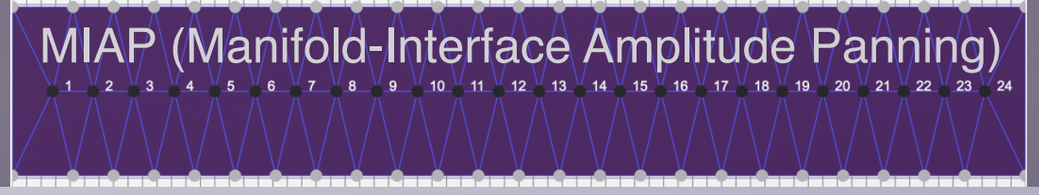
Non-Centricity in SpaceMap:

- How to foreground the rendering mechanisms of given setup without anchoring the language of the tool on a listener origin (i.e. “sweet spot”)?

Ellison’s Solution:

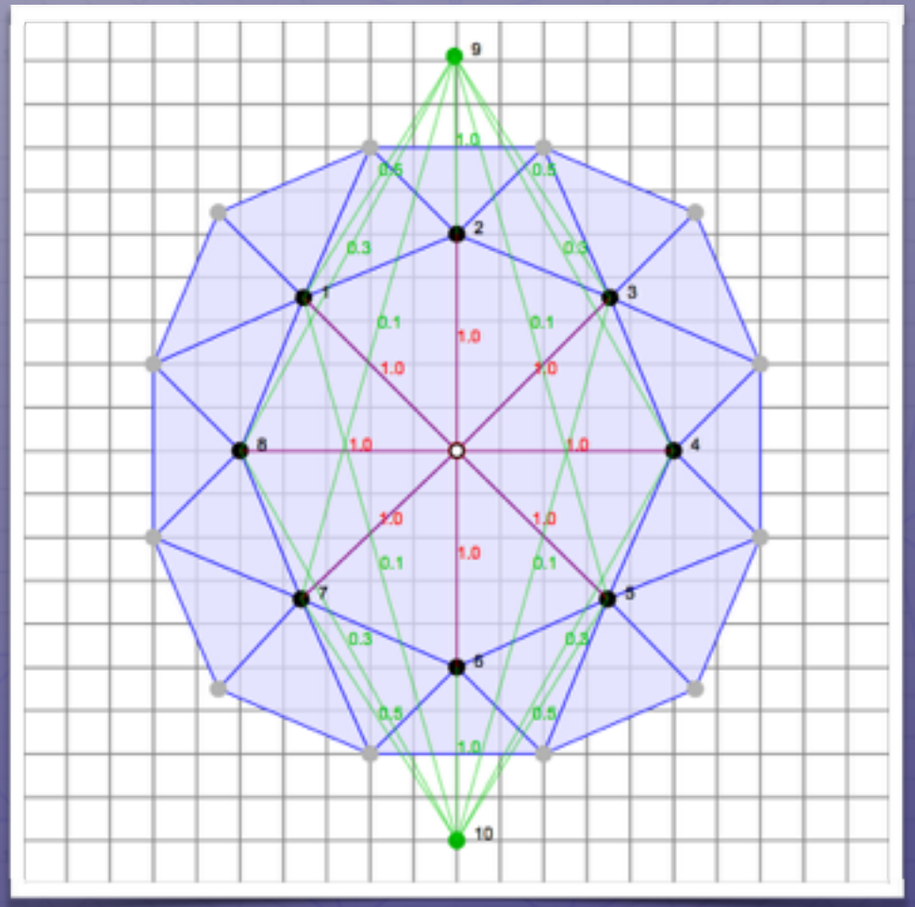
- Abstract the speaker-speaker and speaker-listener relationships away from real-space, and redefine those relationships on a two-dimensional topological space, also known as a ***manifold.***

Two-dimensional manifolds are called surfaces or *maps*



From Meyer Sound's CueStation User Guide:

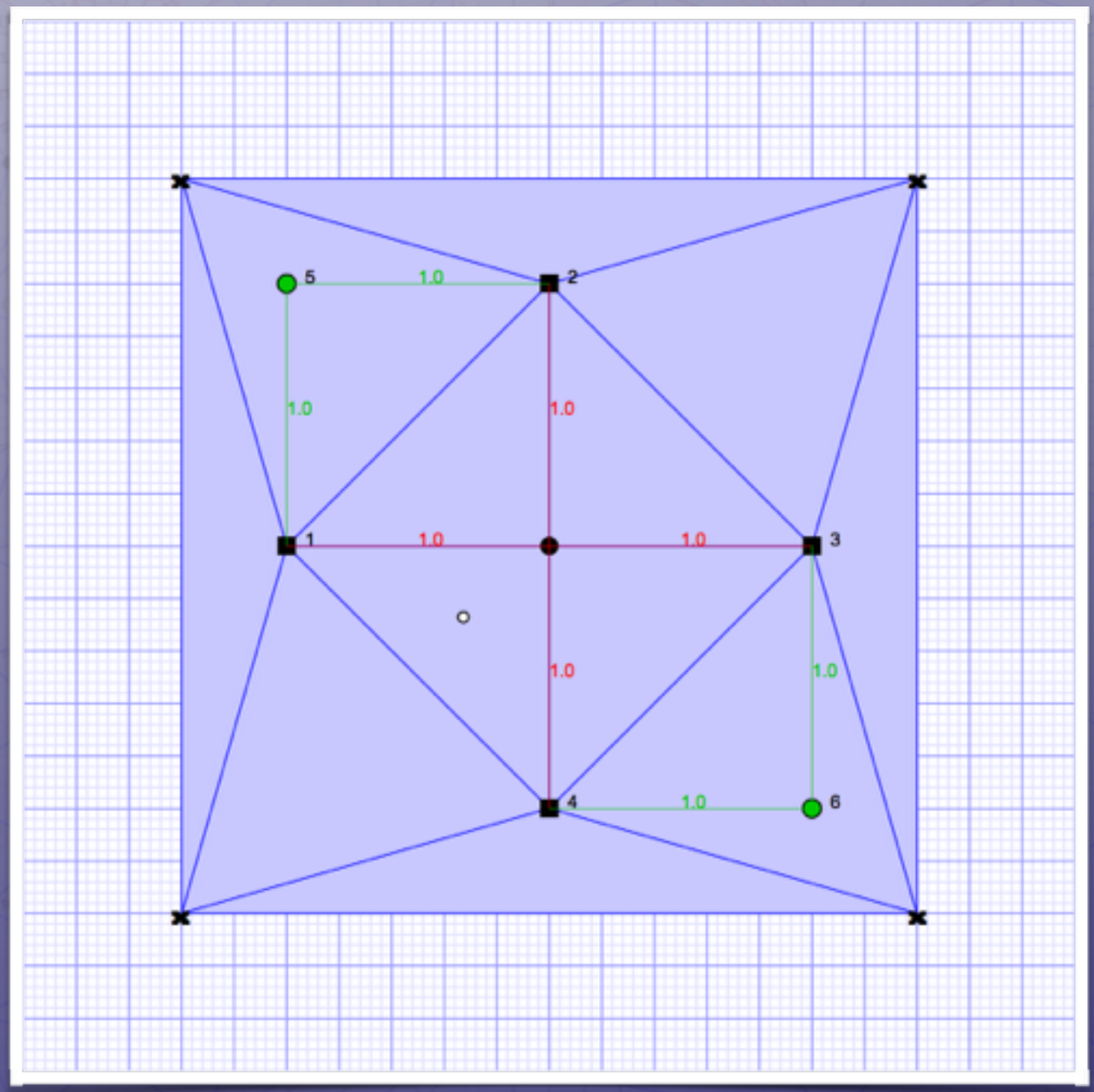
"A SpaceMap design is constructed from two basic elements: nodes and trisets. Nodes commonly represent the positions of loudspeakers or groups of speakers, and may be of several types. Trisets link three nodes together, providing the means to distribute signal proportionally among them."

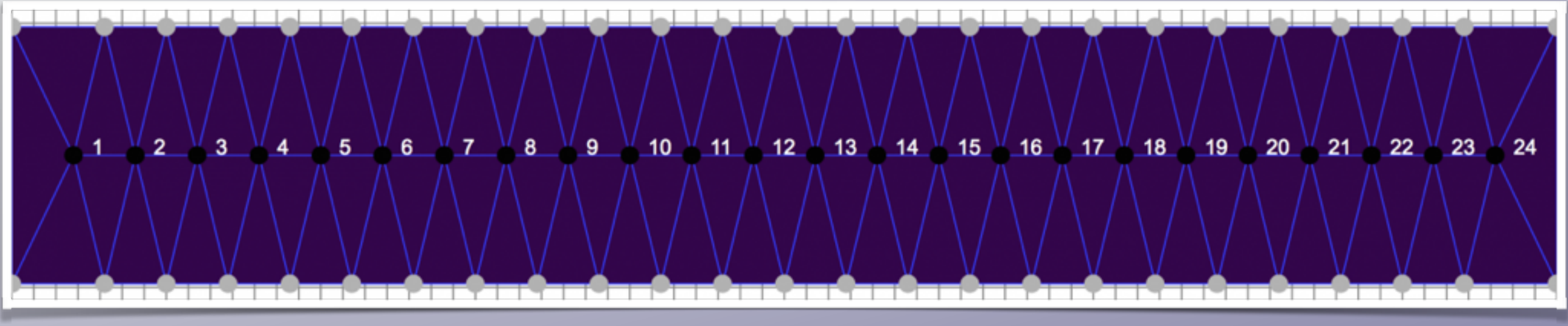


Elements of SpaceMap:

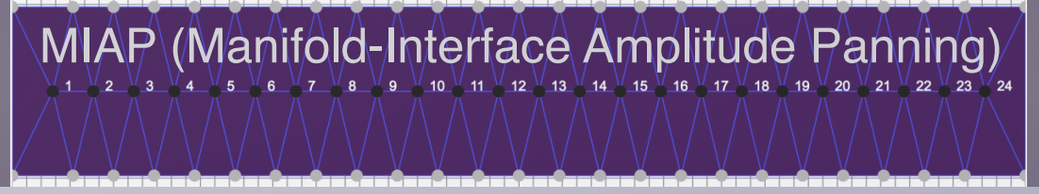
- single speakers (**Speaker Node**)
- groups of speakers (**Virtual Node**)
- points of silence (**Silent Node**)
- single speakers with derived audio source (**Derived Node**)

A map with all four node types





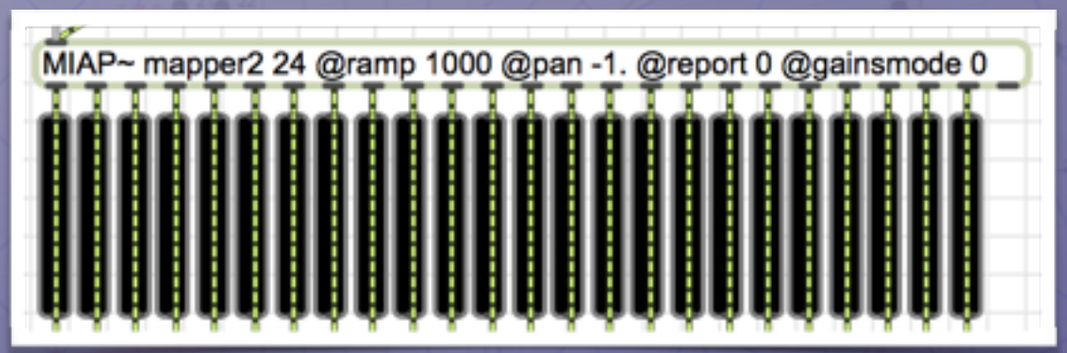
Demonstration of SpaceMap Concepts via MIAP Software

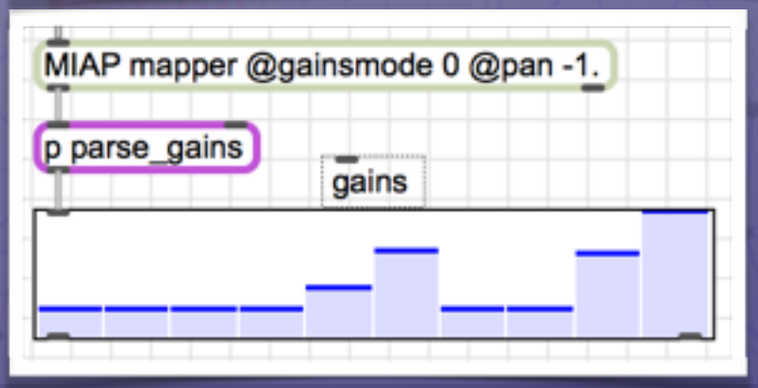


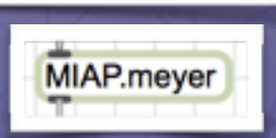
MIAP = Manifold-Interface Amplitude Panning

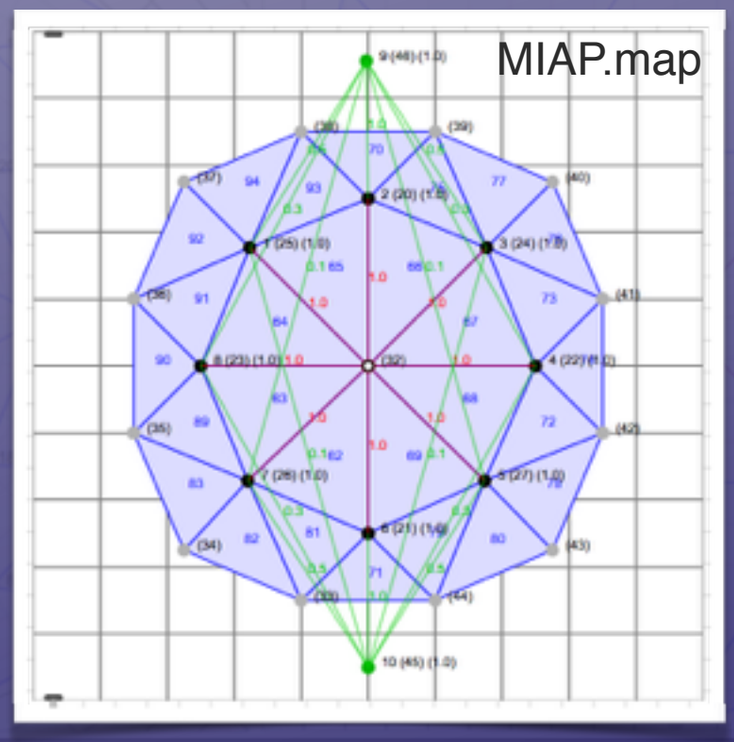
- Suite of externals for MaxMSP and Pure Data that provides an expanded implementation of SpaceMap functionality.
- Serves as a vehicle for the exploration of new applications/ implementations of the “manifold-interface” approach.

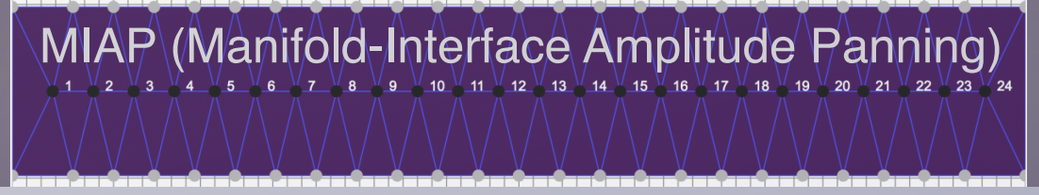
MIP?? (Manifold-Interface Panning)





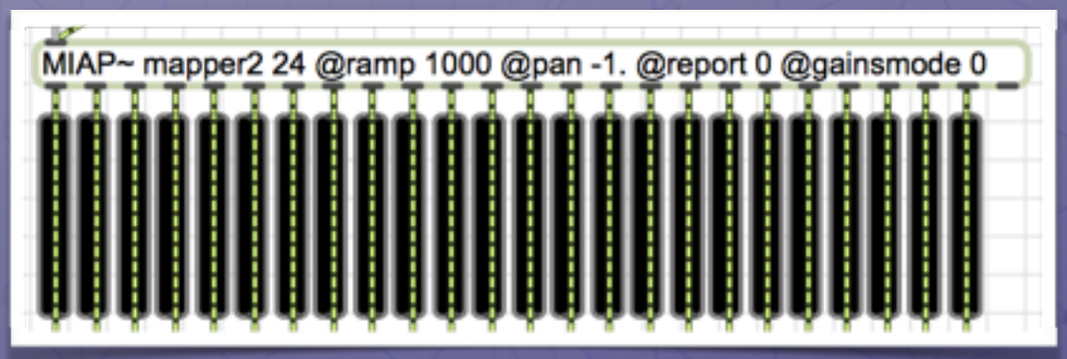


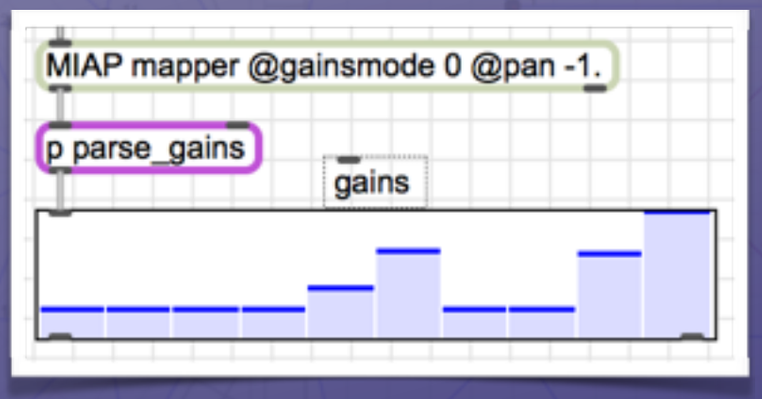


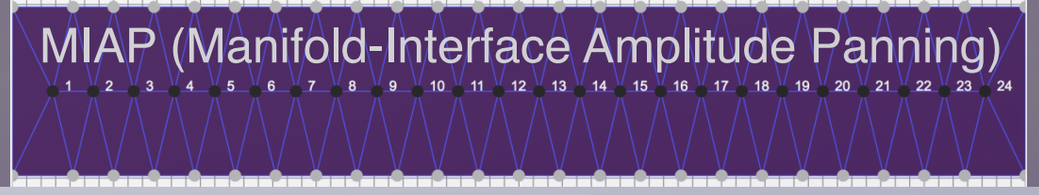


MIAP and MIAP~

- Read, write, interact with maps (stored in JSON format).
- Create and edit maps.
- Pan between maps
- Adjust node/map properties (e.g. global divergence, map panning curve, silent node weighting, etc.)

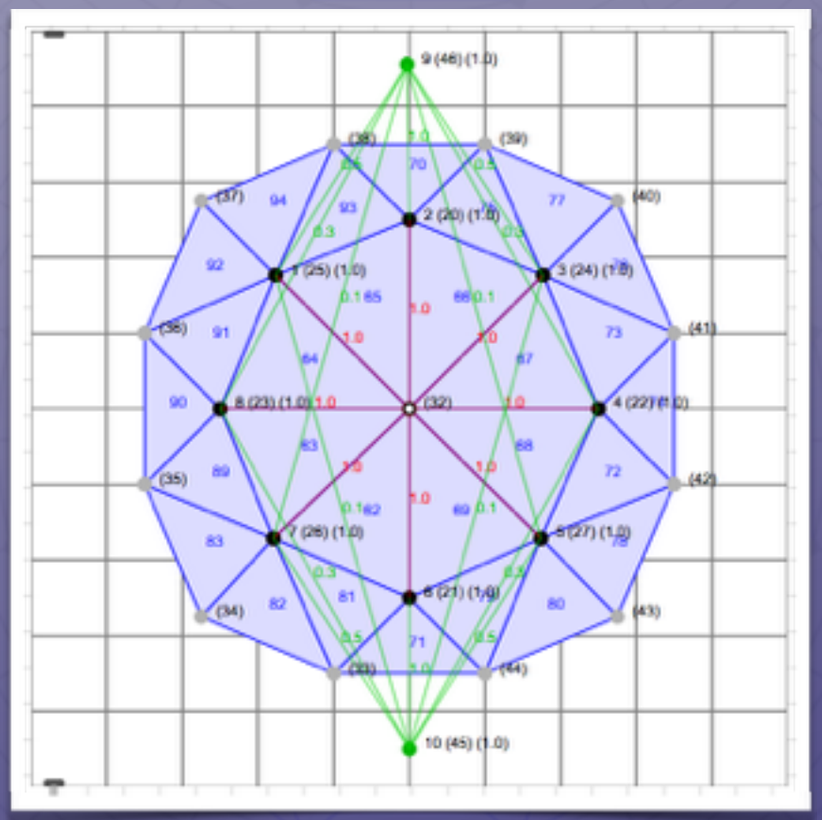


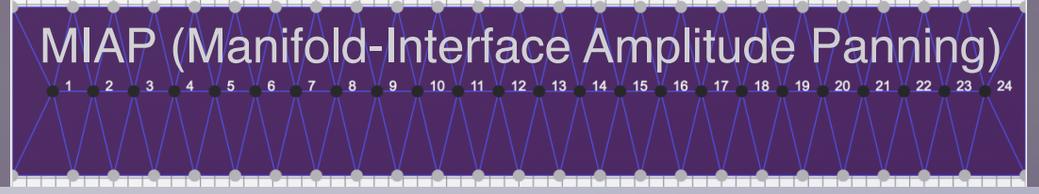




MIAP.map

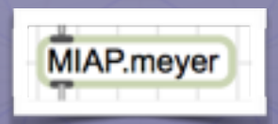
- Bind to and display maps in MIAP/MIAP~ panner objects
- Visually navigate and control maps
- Adjust display of map information (e.g. node trims, etc.)
- Adjust appearance of map elements (e.g. node size, etc.)

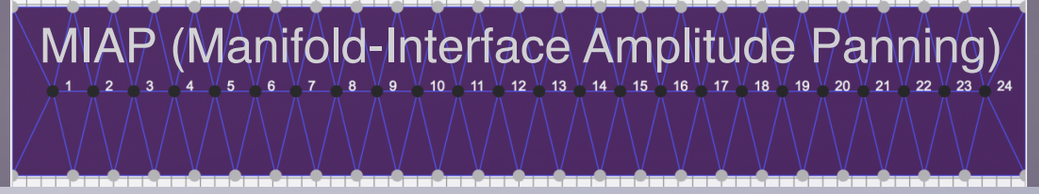




MIAP.meyer

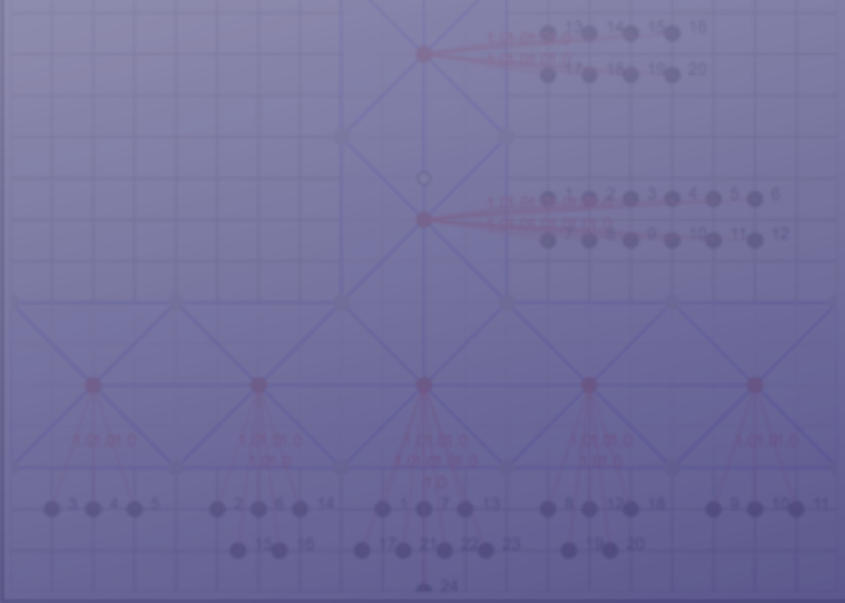
- Convert maps and trajectories from Meyer's D-Mitri and Matrix3 project file format to MIAP-native JSON files

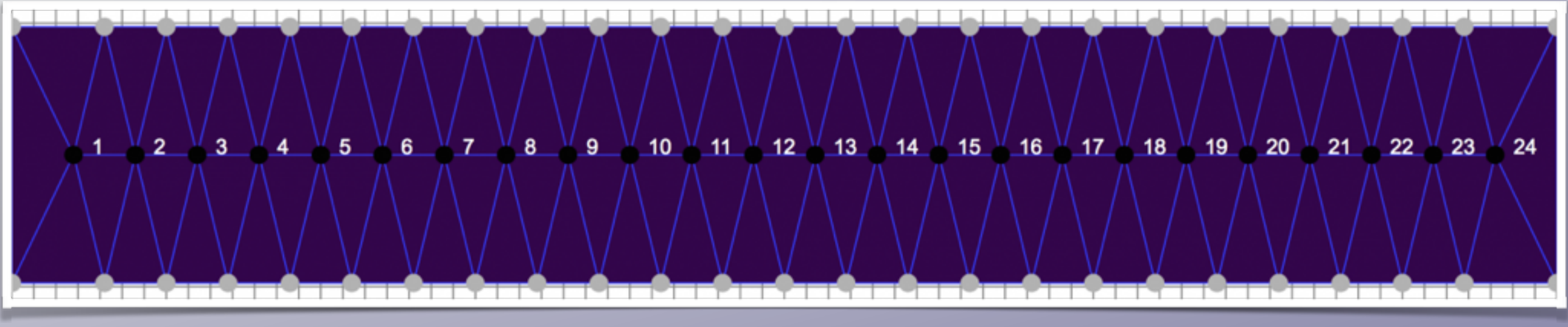




Next Steps:

- Create MIAP.map object for Pure Data
- Add intuitive GUI-based map authoring in MIAP.map
- Expand algorithm beyond triangular sets
  (e.g. Christian Borß' *"Edge-Fading Amplitude Panning"*)
- Expand use of barycentric coordinates to 3 dimensions
  (e.g. tetrahedrons vs. triangles)





THANK YOU!

contact: zseldess@gmail.com

Download the software (it's free!):
http://www.zacharyseldess.com/miap

Special thanks to Steve Ellison, Jeremy Friesner, Richard Bugg, and everyone at Meyer Sound Laboratories, Inc. for their generous assistance