

Perspective

multiple perspective, non-linear projection

Multiple perspective



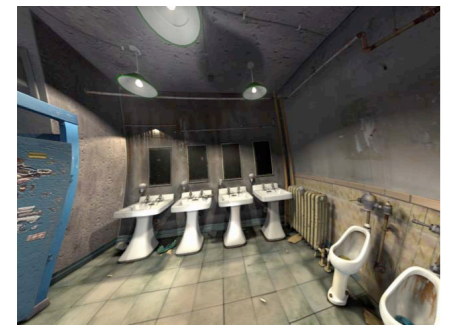
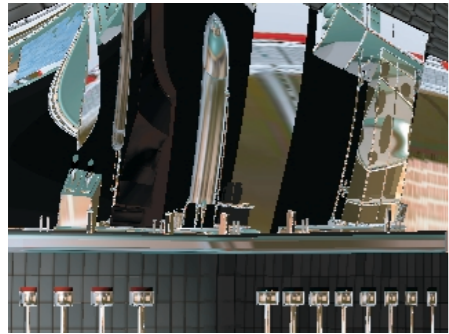
JANUSZ SZCZUCKI
Multiple perspective

Non-linear perspective



Getty Images

Outline



- Representation systems (projection and perspective)
- Alternative perspectives in Computer Graphics (multiple perspective, non-linear)
- Glassner - multiple perspective rendering
- Agrawala - multiple perspective projection
- Singh - non-linear projection (based on multiple perspectives and based on distortions of geometry)

Representation Systems



Singh, RYAN

Consider the problem of representing or depicting a scene in a lower dimension - *projection*.

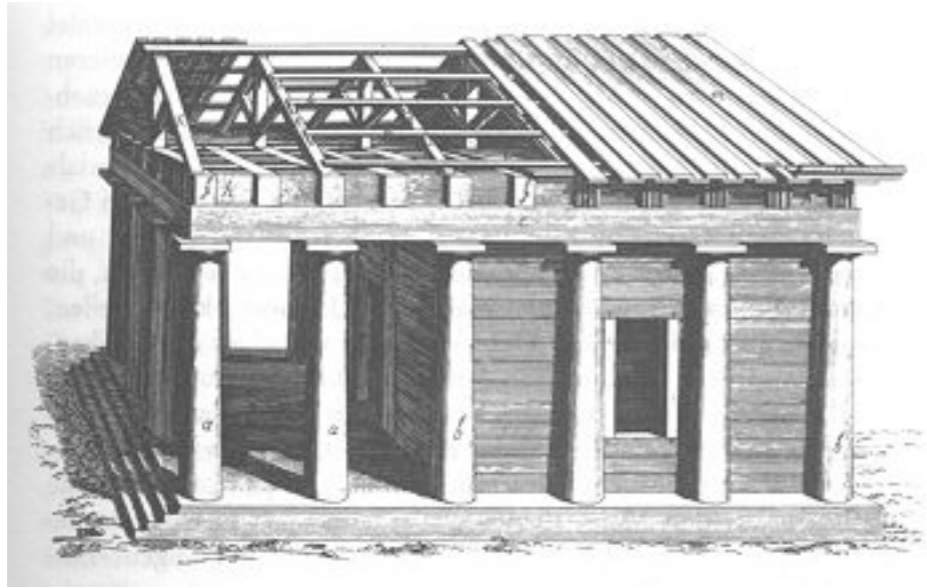
- Parallel Systems - orthographic, oblique, axonometric, and isometric projections.
- Perspective - linear perspective (single-point, many-point), non-linear perspective/projection.
- Mixed systems and multiple perspectives in a single representation.

Object-based

View-based

Mixed

Parallel Projection

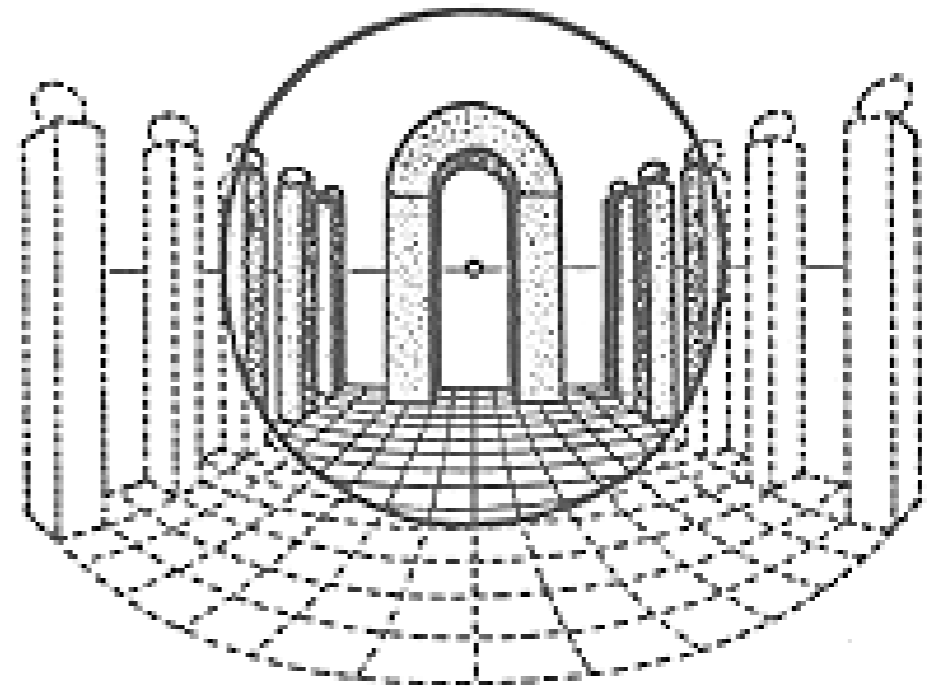
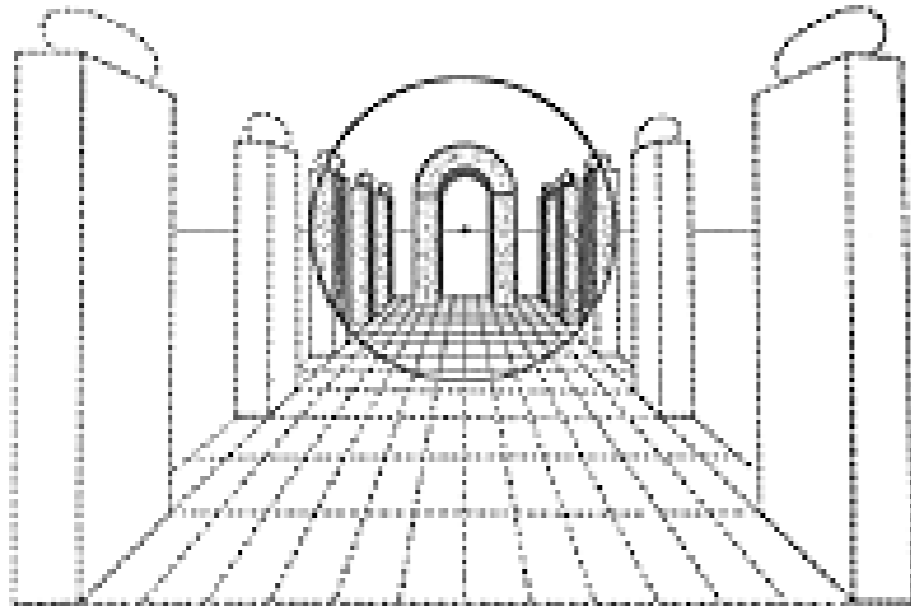


Borromini

In this case, orthogonals (projection rays in third dimension) are parallel.

- Object-centric, viewer independent.
- Used in early art, Eastern art, mechanical and architectural drawings, used in modern art (cubism, surrealism, expressionism).

Perspective



Bruce MacEvoy, 2004

Linear single-point perspective

Non-linear perspective

- View point-centric.
- Linear vs. curvilinear: uses vanishing curves instead of vanishing lines or points.

Mixed Systems



Breakfast 1914, Juan Gris



School of Athens, Raphael

- Multiple oblique projections and multiple perspectives combined into one drawing system. Done intentionally for different reasons.



3D Representation



- Nonlinear and multiple perspective in 3D... time dimension or spatial location as view point can be multiple or non-linear.

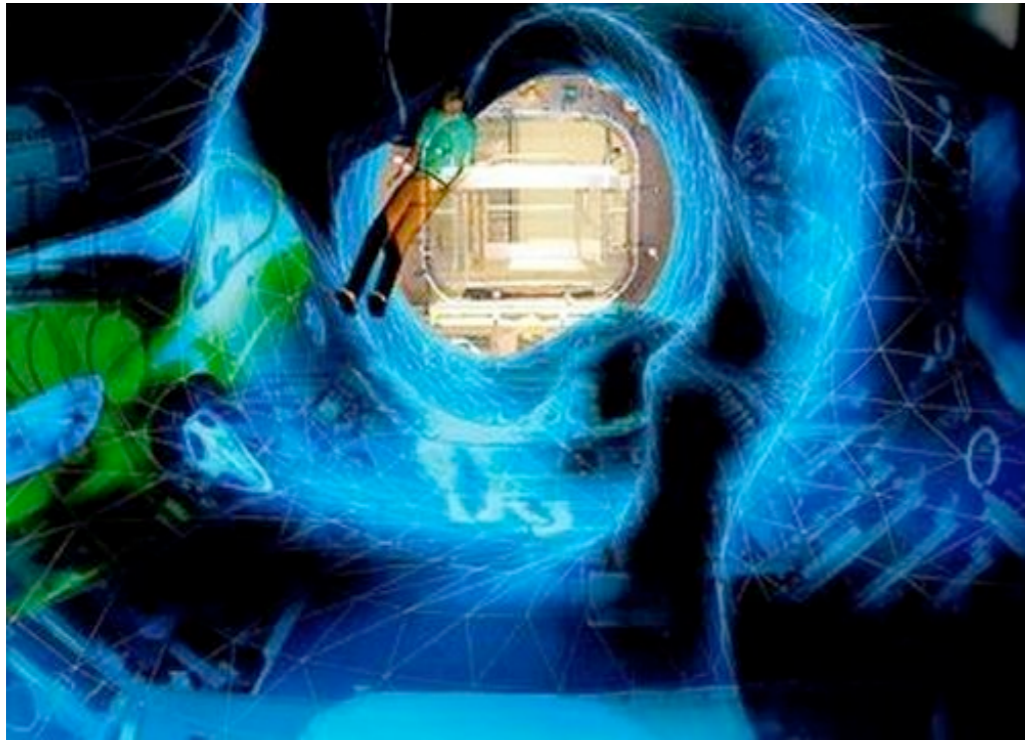
Frank O. Gehry
MIT Strata Center

Alternative Projections/Perspectives to CG staple (single-point perspective)

- Alternatives are: mixed systems (religious art), multiple projections (cubism), multiple perspectives (Hockney, camera path drawings), curvilinear perspectives (imax, wide-angle, fish eye), non-linear and 3D warps.
- Used especially for expressive or representational reasons (i.e. divorce from viewer, make unreal, give best view).

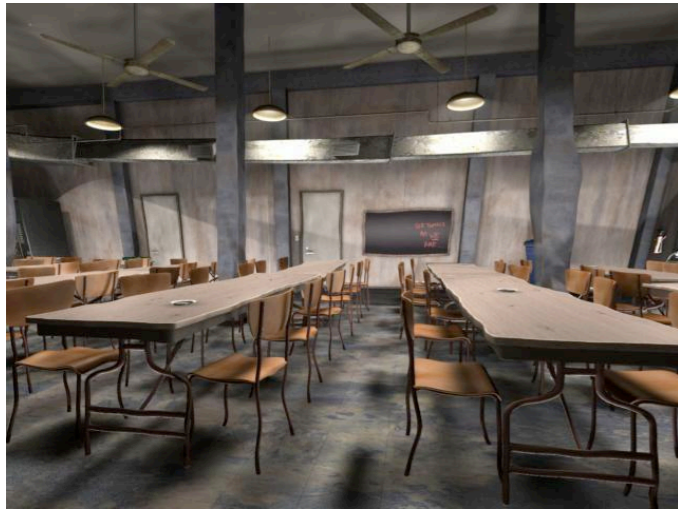
Applications

- Projection on large surfaces (reduce distortion).
- Immersive environments.
- IBR (warping, mapping).
- View-independent rendering.
- Better representation of data and local regions.
- Expressive CG imagery and animation.
- Simultaneous views of scene and data.



"Space Module"
Kasa Usterhjus

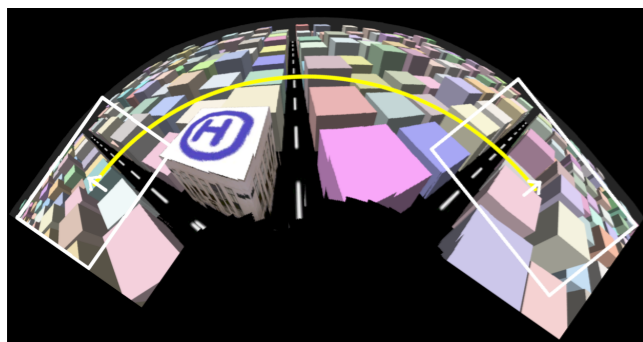
Non-linear Perspective Projections in CG



RYAN, Coleman and Singh



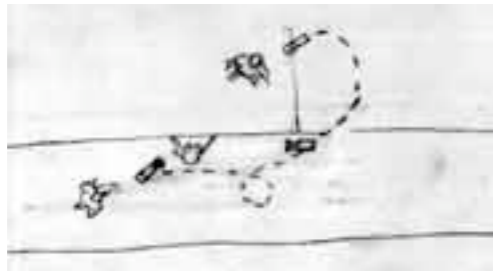
Cubism and Cameras, Glassner



Multiperspective Panoramas for Cel
Animation, Wood et al

- Lots of work being done: image warping, 3D projections, multi-perspective panoramas.
- Multi-projection rendering.

Cubism and Cameras... : Glassner



- “Suppose you could take a camera - lens, film, and all - and stretch it like a blob of Silly Putty. You could wrap it around people, simultaneously capturing them from all directions.”
- **Cubist Camera:** presents many interpretations and points of view simultaneously.

Cubism and cameras... : Glassner

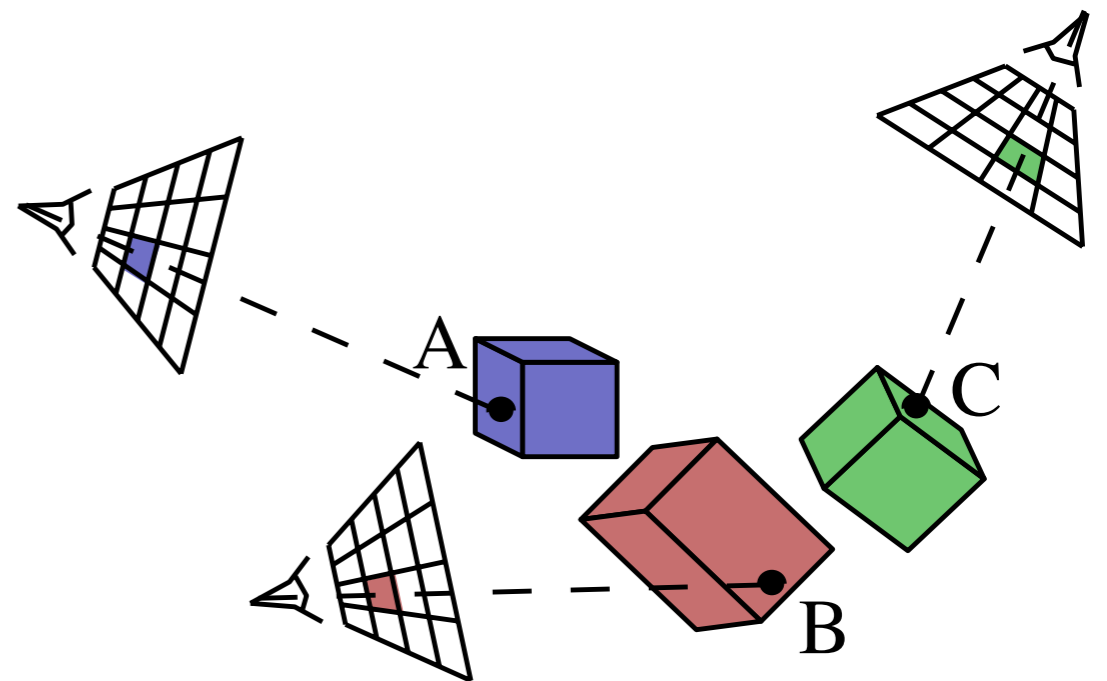


- Glassner combines multiple non-linear perspectives to make the imagery seamless and continuous. The non-linearity of the perspectives allows them to be merged more easily.
- Implemented as a material plug-in that alters the ray by an 'eye' surface and a 'lens' surface. Example of *nonlinear ray tracing*.
- Nonlinear raytracing handles lighting, but can cause artifacts.

Artistic multiprojection rendering: Agrawala, Zorin, Munzer

- A tool for creating multi-projection (of multiple perspectives) images and animations.
- Given scene geometry, UI to position local and master cameras. Algorithm for multi-projection that solves occlusions.

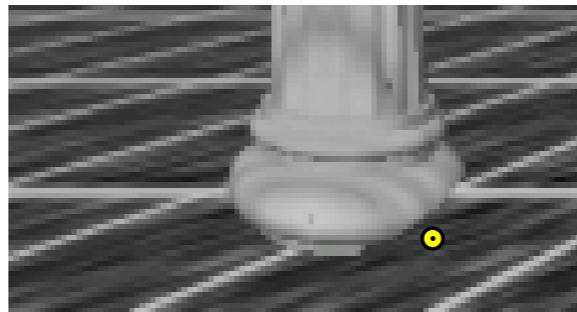
Algorithm must: resolve visibility, constrain cameras (choose best projections or perspectives), and perform interactive rendering.



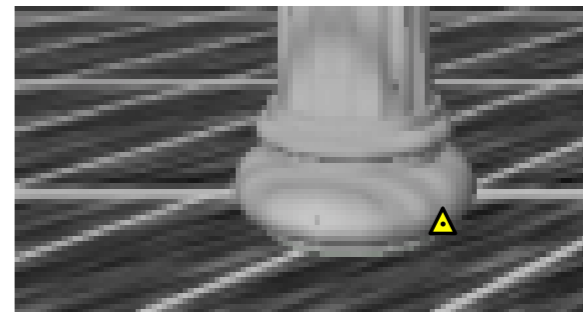
Artistic multiprojection rendering: Agrawala, Zorin, Munzer



(a) Single projection master camera view



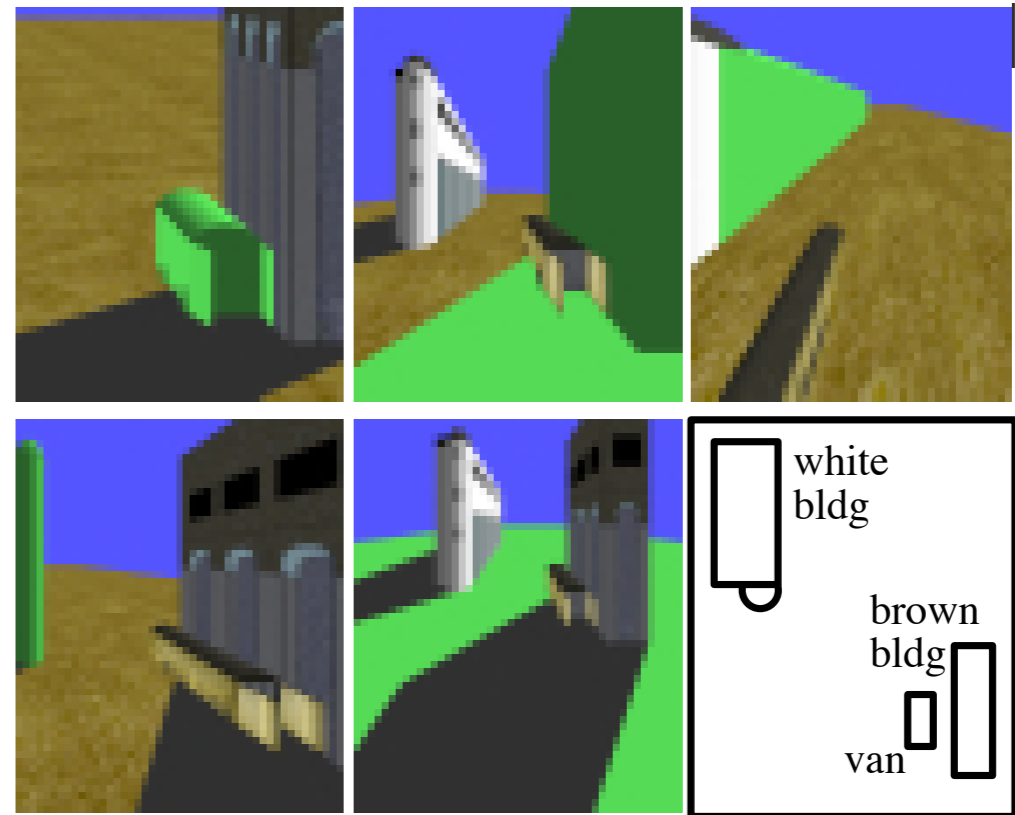
(b) Multiprojection with depth compositing only



(c) Multiprojection with occlusion constraints and depth compositing

- Each scene object is assigned to a local camera.
- Visibility is difficult because of inconsistent depth ordering. Use a ‘master camera’ and object-based occlusion constraints.
- Camera Constraints: for use in animations, based on best camera placement or movement for local scenes (object size, fixed-view, fixed-position, direction and orientation).

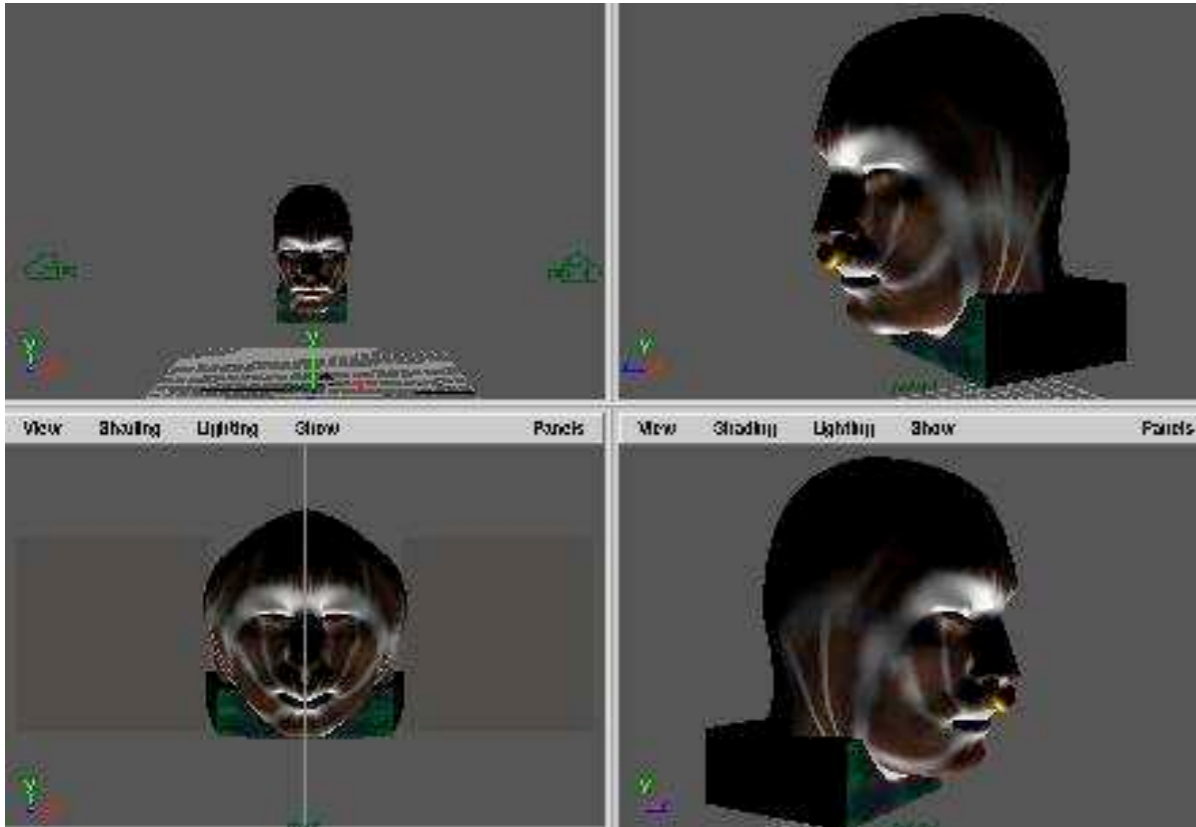
Artistic multiprojection rendering: Agrawala, Zorin, Munzer



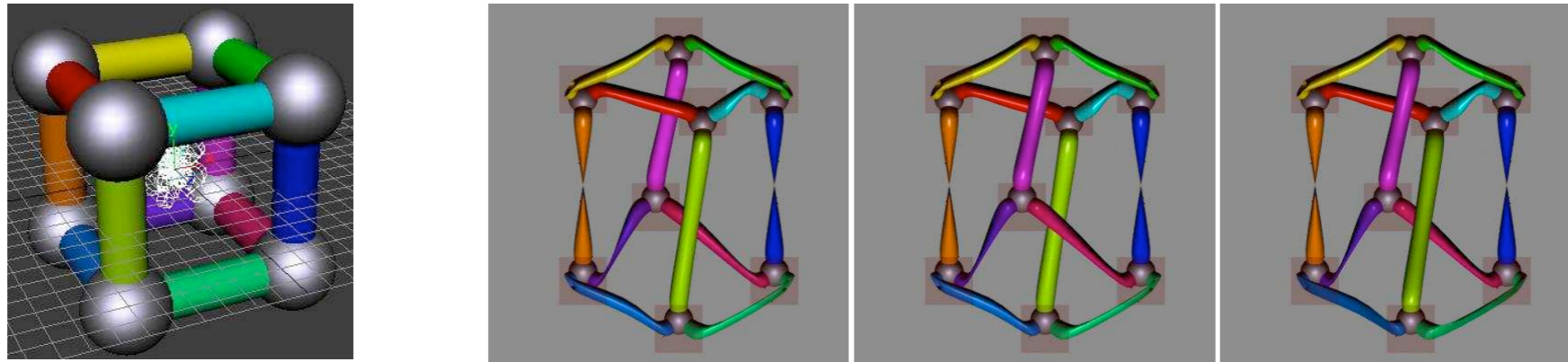
- Fixes distortions, creates surrealist and toony styles.
- Good when objects disjoint.
- Doesn't solve lighting and shadow problems.

A fresh perspective: Karan Singh

- Creates images from a nonlinear perspective by combining the perspectives of multiple cameras.
- Different from Agrawala because resulting image of each object is potentially influenced by all cameras.
- Can create more continuous multi-perspectives to actually attain a 'non-linear' perspective.

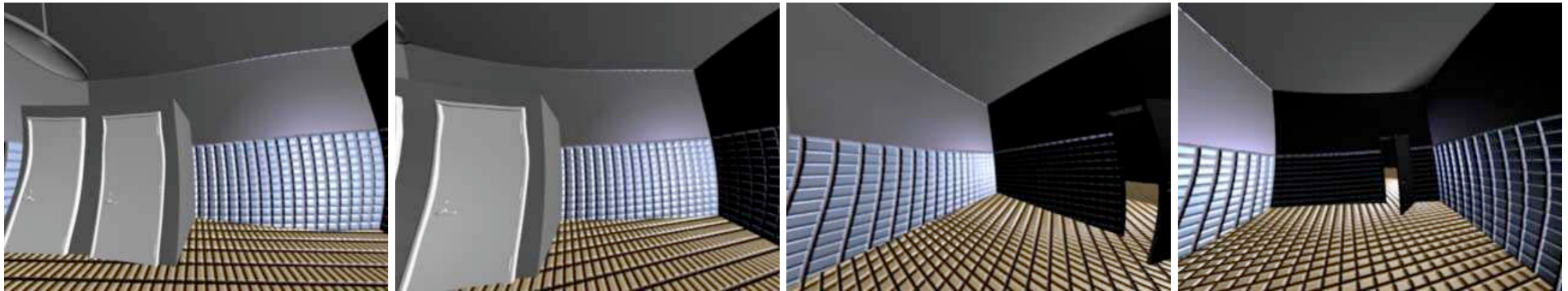


A fresh perspective: Karan Singh



- Interactive and familiar approach.
- Can weight cameras based on distance from object or viewing direction of camera (localizes effect of camera).
- Does not handle illumination issues and does not control global scene coherence.

RYAN: Rendering your animation nonlinearly projected



- Nonlinear projection system that integrates into the conventional animation workflow.
- Interactive techniques to control and render scenes using nonlinear projections.
- A linear combination of linear perspectives.

RYAN: Rendering your animation nonlinearly projected

1. Distorts scene geometry so under linear perspective appears nonlinearly perspective.
2. Provides interactive authoring of nonlinear projections with scene constraints and linear perspective cameras.
3. Addresses nonlinear projection's effect on rendering and illumination.

In a mixed perspective scene, the goal is to keep qualities of global coherence and local distortions of geometry and shading result from the changes in perspective.

RYAN: Rendering your animation nonlinearly projected

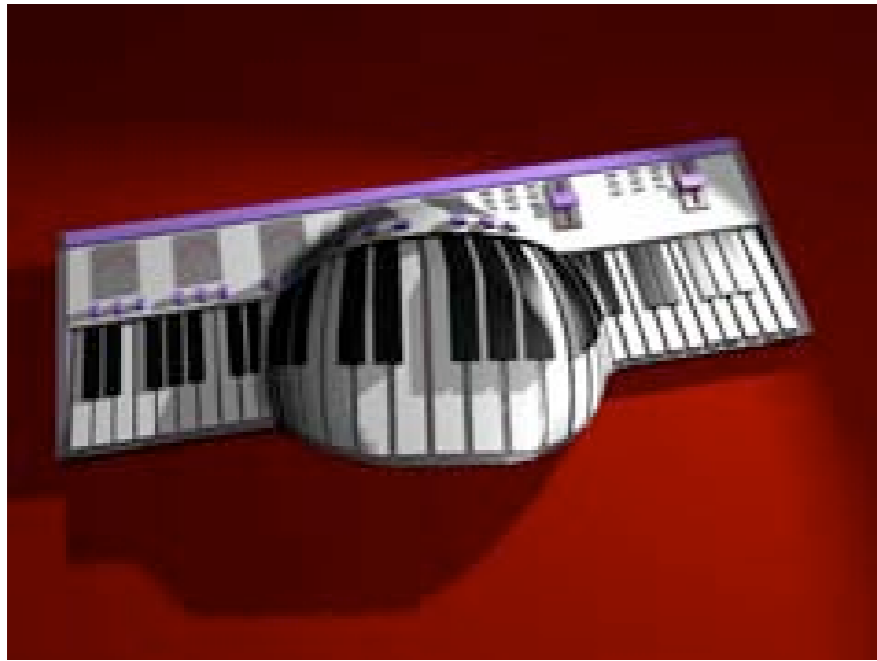
- **Boss** camera is the traditional linear perspective.
Lackey cameras represent local linear views.
- Lackey camera deforms objects (in scene space) so that through the boss camera, they have view properties of the lackey, depending on weight of lackey for the objects.
- Incorporate the multiple views of the lackey cameras into the illumination calculations.

RYAN: Rendering your animation nonlinearly projected



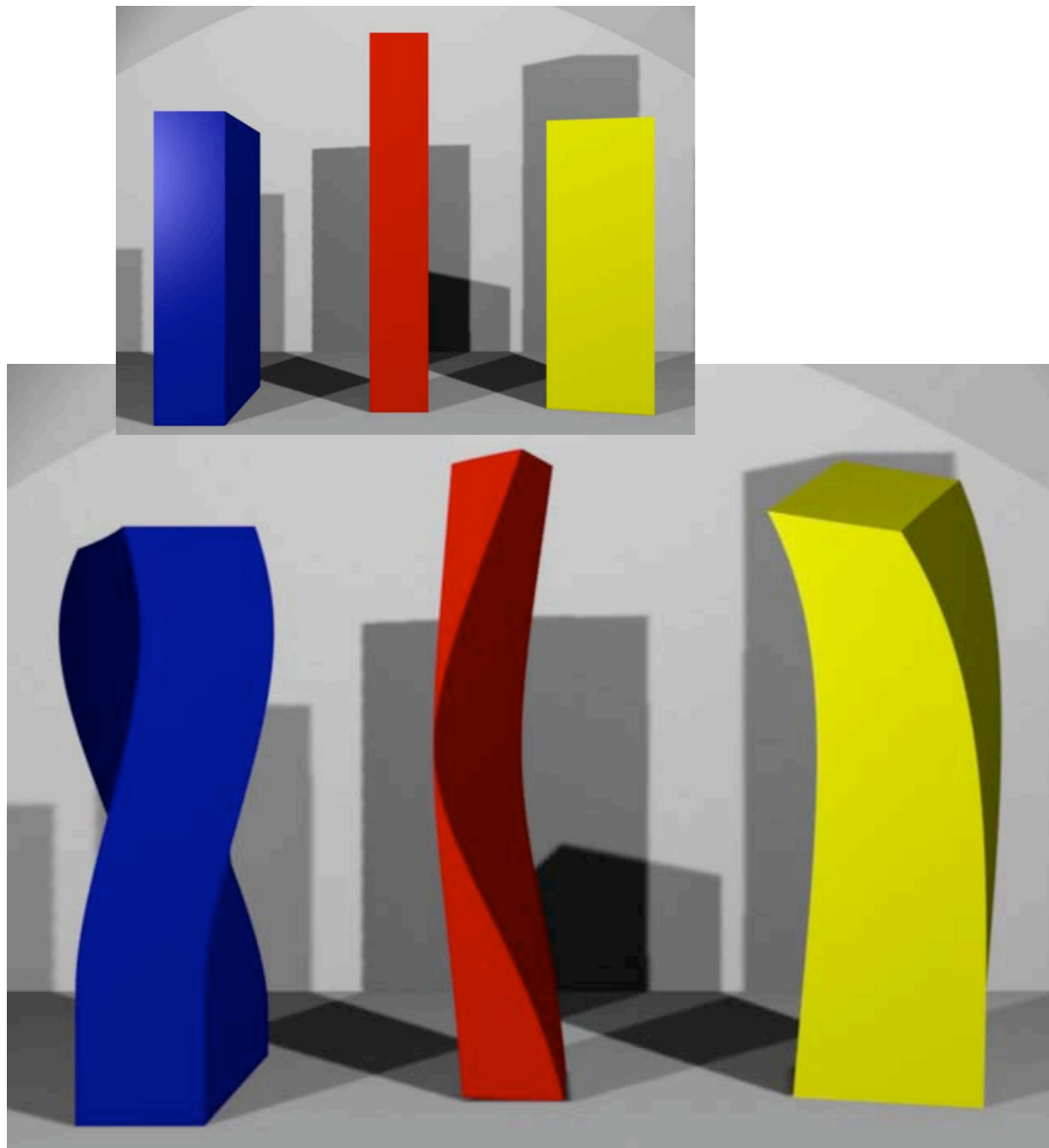
- Constraints maintain global coherence (and stop walls from collapsing).
- Camera weights restrict influence.
- Chained lackeys (in-betweens) for better interpolation between boss and lackey and for better illumination blending.

RYAN: Rendering your animation nonlinearly projected



- Use original geometry so shading is not based on the deformed geometry.
- Illuminate by blending illumination of boss and lackey cameras, or set a single view point for lighting.

RYAN: Rendering your animation nonlinearly projected



References

- Maneesh Agrawala, Denis Zorin, Tamara Munzner - Artistic Multiprojection Rendering, Appears in Eurographics Rendering Workshop 2000,
- Fred Dubery and John Willats, Perspective and Other Drawing Systems by in Back Flap
- Patrick Coleman and Karan Singh, RYAN: Rendering Your Animation Nonlinearly projected. NPAR 2004.
- Karan Singh, A Fresh Perspective.
- Daniel N. Wood, Adam Finkelstein, John F. Hughes, Craig E. Thayer, David H. Salesin - Multiperspective Panoramas for Cel Animation, Proceedings of SIGGRAPH 97
- Glassner, Andrew S., "Cubism and Cameras: Free-form Optics for Computer Graphics", Microsoft Research, January 2000.
- <http://www.gettyimages.com>
- EECS MIT <http://www.eecs.mit.edu>
- <http://www.archcenter.ru/eng/news/fluidarh/default.asp>
- Janusz Szczucki - Multiple perspective. Mala Gallery, Warsaw, Poland, January 2000