**1. Cyclogenesis: Simulating Hurricanes and Tornadoes**

**Summary:**  
This paper presents a method to realistically simulate hurricanes and tornadoes by combining heat, moisture, turbulence, and cyclone dynamics. The system can generate visually convincing and physically grounded animations of large storms.

**Background Knowledge Required:**

* Fluid simulation (Navier–Stokes, turbulence)
* Basic atmospheric physics (heat, moisture, buoyancy)
* Computer graphics techniques for volumetric rendering

**Future Works:**

* Improve physical accuracy with more detailed cloud/atmosphere models
* Handle larger scales and higher resolutions efficiently
* Integrate live weather data for real-time simulations
* Enhance visual realism (lighting, scattering, cloud detail)

**2. Scintilla: Simulating Combustible Vegetation for Wildfires**

**Summary:**  
This paper introduces a method to simulate how vegetation burns during wildfires, capturing ignition, combustion, and smoke. It models how plants react to fire for realistic wildfire animations.

**Background Knowledge Required:**

* Fluid and combustion simulation
* Vegetation/plant modeling in graphics
* Volumetric rendering of smoke and fire

**Future Works:**

* More detailed plant physiology (moisture, density)
* Larger-scale wildfire spread models
* Integration with real fire data for prediction
* Improved realism of fire–vegetation interactions

**3. Interactive Invigoration: Volumetric Modeling of Trees with Strands**

**Summary:**  
Presents a tree modeling approach using volumetric strands, enabling realistic and interactive tree creation. It allows users to generate detailed tree structures quickly and intuitively.

**Background Knowledge Required:**

* Procedural modeling (trees, plants)
* Geometry and volumetric representation
* Interactive graphics systems

**Future Works:**

* Extending to simulate growth over time
* Integration with physics (wind, weight)
* Applying method to other vegetation types
* Enhancing rendering realism

**4. One Noise to Rule Them All: Learning a Unified Model of Spatially-Varying Noise Patterns**

**Summary:**  
Proposes a machine learning model that learns many types of noise patterns (e.g., wood, stone, fabric) in one unified framework, instead of designing them manually.

**Background Knowledge Required:**

* Procedural textures and noise in graphics
* Machine learning for pattern synthesis
* Spatially-varying functions in rendering

**Future Works:**

* Training on more diverse real-world materials
* Faster generation for real-time rendering
* Extending beyond visual textures (sound, motion)
* Interactive tools for artists

**5. Alignment conditions for NURBS-based design of mixed tension-compression grid shells**

**Summary:**  
Introduces alignment conditions for designing architectural grid shells using NURBS, balancing tension and compression forces for stable structures.

**Background Knowledge Required:**

* NURBS (Non-Uniform Rational B-Splines) geometry
* Structural engineering concepts (tension/compression)
* Computational design for architecture

**Future Works:**

* Extend to more complex freeform architectural surfaces
* Integration with optimization algorithms
* Real-world case studies and validations
* Automated design workflows

**6. Spin-It Faster: Quadrics Solve All Topology Optimization Problems That Depend Only On Mass Moments**

**Summary:**  
Presents a method using quadrics to efficiently solve topology optimization problems where only mass moments matter, making structural optimization faster and simpler.

**Background Knowledge Required:**

* Topology optimization techniques
* Quadrics mathematics and geometry processing
* Structural mechanics concepts

**Future Works:**

* Apply to broader classes of optimization problems
* Improve scalability for large 3D models
* Combine with real-world engineering constraints
* Extend beyond mass-moment-based designs

**7. Multi-Material Mesh-Based Surface Tracking with Implicit Topology Changes**

**Summary:**  
Proposes a mesh-based method to track surfaces with multiple materials while handling automatic splitting/merging of geometry. Useful for simulating liquids or deformable objects with changing topology.

**Background Knowledge Required:**

* Mesh-based surface tracking
* Computational geometry and topology
* Multi-material simulation in graphics

**Future Works:**

* Scaling to larger, more complex simulations
* Better handling of thin structures and fine detail
* Integration with real-time simulation systems
* Applications in visual effects and engineering

**8. Going with the Flow**

**Summary:**  
Presents a mathematical framework for analyzing and processing geometric flows, enabling new ways to simulate and manipulate evolving surfaces.

**Background Knowledge Required:**

* Differential geometry and geometric flows
* Numerical methods for PDEs
* Geometry processing in computer graphics

**Future Works:**

* Extend to more practical animation/visualization tasks
* Improve computational efficiency
* Apply to real-world shape analysis problems
* Combine with machine learning methods

**9. Neural Slicer for Multi-Axis 3D Printing**

**Summary:**  
Introduces a neural-network-based slicer for multi-axis 3D printing, producing toolpaths that reduce support structures and improve print quality.

**Background Knowledge Required:**

* 3D printing processes (multi-axis)
* Path planning and slicing algorithms
* Neural networks for geometry optimization

**Future Works:**

* Expand to more printer types and materials
* Speed up inference for industrial use
* Integrate with CAD systems
* Improve robustness on complex models

**10. DreamMat: High-quality PBR Material Generation with Geometry- and Light-aware Diffusion Models**

**Summary:**  
Uses diffusion models to generate physically based materials (PBR) by considering both geometry and lighting, producing high-quality realistic textures.

**Background Knowledge Required:**

* Physically Based Rendering (PBR)
* Diffusion models in generative AI
* Texture/material generation in graphics

**Future Works:**

* Expand material diversity and dataset coverage
* Speed up generation for real-time use
* Interactive editing tools for artists
* Integration into game/film production pipelines

**11. Text-Guided High-Quality 3D Portrait Generation Using Pyramid Representation and GANs Prior**

**Summary:**  
Presents a text-to-3D portrait generation system using a pyramid representation and GAN priors, creating detailed and realistic head models guided by text input.

**Background Knowledge Required:**

* GANs and diffusion models in 3D generation
* Pyramid/multi-resolution representations
* 3D portrait modeling and rendering

**Future Works:**

* Improve identity preservation and text alignment
* Extend to full-body generation
* Faster training/inference for practical use
* Tools for editing and customization

**12. SketchDream: Sketch-based Text-to-3D Generation and Editing**

**Summary:**  
A system that generates and edits 3D objects based on text and sketch inputs, giving users intuitive control over shape design.

**Background Knowledge Required:**

* Text-to-3D generation methods
* Sketch-based modeling in graphics
* Generative models for 3D content

**Future Works:**

* Support more complex scenes and objects
* Improve accuracy of sketch-to-3D mapping
* Real-time interactive editing
* Broader application in design and AR/VR

**13. Toonify3D: StyleGAN-based 3D Stylized Face Generator**

**Summary:**  
Uses StyleGAN to generate 3D cartoon-like faces from realistic ones, enabling stylized avatars while preserving identity.

**Background Knowledge Required:**

* GANs (StyleGAN in particular)
* 3D face modeling and rendering
* Neural style transfer techniques

**Future Works:**

* Extend to full-body stylization
* More control over artistic style levels
* Real-time applications in games/VR
* Larger, more diverse datasets

**14. Deep Hybrid Camera Deblurring for Smartphone Cameras**

**Summary:**  
Proposes a deep-learning approach combining multiple camera inputs to remove motion blur in smartphone photos, improving image sharpness.

**Background Knowledge Required:**

* Image deblurring techniques
* Deep learning for image restoration
* Camera imaging models

**Future Works:**

* Extend to video deblurring
* Real-time implementation for mobile devices
* Handle extreme low-light conditions
* Broader generalization across devices

**15. 3Doodle: Compact Abstraction of Objects with 3D Strokes**

**Summary:**  
Introduces a method to represent 3D objects using compact stroke-based abstractions, making them simpler yet recognizable.

**Background Knowledge Required:**

* 3D shape abstraction and simplification
* Stroke-based rendering and modeling
* Geometry compression techniques

**Future Works:**

* Extend to animate doodle-like models
* Apply to VR/AR for lightweight rendering
* More control over abstraction levels
* Style adaptation for different art forms

**16. Progressive Dynamics for Cloth and Shell Animation**

**Summary:**  
Proposes a progressive simulation method that allows stable and efficient animation of cloth and thin shells with fewer computational costs.

**Background Knowledge Required:**

* Cloth and shell physics in graphics
* Simulation algorithms (finite elements, dynamics)
* Animation systems in computer graphics

**Future Works:**

* Real-time applications in games/VR
* Extend to multi-layered or complex materials
* Integration with character animation pipelines
* Handling extreme deformations robustly

**17. Stylized Rendering as a Function of Expectation**

**Summary:**  
Explores a framework where stylized rendering is guided by human perceptual expectations, producing results that look natural yet expressive.

**Background Knowledge Required:**

* Non-photorealistic rendering (NPR)
* Human perception in graphics
* Style transfer techniques

**Future Works:**

* Apply to animations and interactive media
* User-controllable perception-based styling
* Broader range of artistic rendering styles
* Integration with AR/VR visualization

**18. Spin-Weighted Spherical Harmonics for Polarized Light Transport**

**Summary:**  
Introduces spin-weighted spherical harmonics to accurately simulate polarized light transport, improving realism in scenes with complex lighting.

**Background Knowledge Required:**

* Light transport theory and rendering equations
* Spherical harmonics in graphics
* Polarization physics

**Future Works:**

* Optimize for faster rendering in production
* Extend to more general lighting models
* Combine with machine learning accelerations
* Applications in cinematography and optics

**19. Stochastic Computation of Barycentric Coordinates**

**Summary:**  
Presents a stochastic approach for computing barycentric coordinates, making it more efficient and robust for graphics and geometry applications.

**Background Knowledge Required:**

* Barycentric coordinates in geometry
* Stochastic and Monte Carlo methods
* Mesh processing techniques

**Future Works:**

* Apply to higher-dimensional geometry
* Optimize for real-time graphics
* Broader adoption in animation and simulation
* Combine with parallel GPU methods

**20. Kinetic Simulation of Turbulent Multifluid Flows**

**Summary:**  
Develops a kinetic-based method to simulate turbulence in flows with multiple interacting fluids, improving realism of liquid animations.

**Background Knowledge Required:**

* Fluid simulation and turbulence modeling
* Kinetic theory methods
* Multi-fluid interaction in graphics

**Future Works:**

* Scale to large fluid domains
* Integration with visual effects pipelines
* Support for complex material interactions
* Faster GPU-based implementations

**21. Lightning-fast Method of Fundamental Solutions**

**Summary:**  
Proposes a very efficient method of fundamental solutions (MFS) to solve physics-based problems faster, useful for simulations in graphics and engineering.

**Background Knowledge Required:**

* Numerical methods for PDEs
* Method of fundamental solutions (MFS)
* Simulation in computer graphics

**Future Works:**

* Apply to wider variety of PDE-based problems
* Improve stability in complex geometries
* Real-time simulation applications
* Integration into interactive tools

**22. Biharmonic Coordinates and their Derivatives for Triangular Meshes**

**Summary:**  
Introduces efficient computation of biharmonic coordinates and their derivatives, improving mesh deformation and editing tasks.

**Background Knowledge Required:**

* Mesh deformation methods
* Biharmonic equations in geometry processing
* Coordinate-based interpolation techniques

**Future Works:**

* Extend to volumetric meshes
* Applications in animation rigs
* Real-time interactive mesh editing
* Improve scalability for large models

**23. Fabric Tessellation: Realizing Freeform Surfaces by Smocking**

**Summary:**  
Presents a technique using fabric smocking to create tessellated freeform surfaces, enabling new textile-based design patterns in graphics and fabrication.

**Background Knowledge Required:**

* Fabric modeling and simulation
* Tessellation and surface geometry
* Digital fabrication techniques

**Future Works:**

* Explore more complex smocking patterns
* Apply to real-time cloth simulation
* Integration with fashion and architecture design
* Extend to multi-material textiles

**24. TexSliders: Diffusion-Based Texture Editing in CLIP Space**

**Summary:**  
Presents a diffusion-based tool that edits textures using sliders in CLIP space, giving intuitive controls for artists to modify visual appearance.

**Background Knowledge Required:**

* Diffusion models in generative AI
* CLIP embeddings for vision-language tasks
* Texture generation/editing in graphics

**Future Works:**

* Extend to 3D texture editing
* Real-time interactive editing tools
* Broader material and texture datasets
* Integration into design software

**25. A Free-Space Diffraction BSDF**

**Summary:**  
Introduces a new BSDF model that accounts for free-space diffraction, improving realism of light interactions with small structures and edges.

**Background Knowledge Required:**

* Bidirectional Scattering Distribution Functions (BSDFs)
* Wave optics and diffraction theory
* Physically based rendering methods

**Future Works:**

* Apply to complex microstructures and materials
* Optimize for faster rendering
* Combine with polarization models
* Use in film and product design rendering

**26. Real-Time Path Guiding Using Bounding Voxel Sampling**

**Summary:**  
Proposes a real-time path guiding method that uses bounding voxel sampling to improve light transport simulation efficiency and quality.

**Background Knowledge Required:**

* Path tracing and path guiding techniques
* Monte Carlo rendering methods
* Voxel-based sampling in graphics

**Future Works:**

* Extend to dynamic scenes
* Reduce memory usage for large environments
* Integrate with real-time ray tracing hardware
* Broader applications in games and VR

**27. Temporally Stable Metropolis Light Transport Denoising using Recurrent Transformer Blocks**

**Summary:**  
Uses recurrent transformer blocks to denoise Metropolis Light Transport (MLT) while maintaining temporal stability across frames.

**Background Knowledge Required:**

* Metropolis Light Transport (MLT)
* Neural denoising techniques
* Transformer architectures

**Future Works:**

* Improve efficiency for production rendering
* Extend to more types of light transport methods
* Real-time temporal denoising for interactive use
* Broader validation on complex scenes

**28. Zero Grads: Learning Local Surrogate Losses for Non-Differentiable Graphics**

**Summary:**  
Introduces a learning-based method to approximate gradients in non-differentiable graphics tasks, enabling optimization where analytic gradients are unavailable.

**Background Knowledge Required:**

* Differentiable rendering and optimization
* Surrogate loss learning in ML
* Non-differentiable graphics pipelines

**Future Works:**

* Extend to more complex rendering tasks
* Improve accuracy of surrogate gradient estimation
* Combine with reinforcement learning approaches
* Applications in inverse rendering and design

**29. Area ReSTIR: Resampling for Real-Time Defocus and Antialiasing**

**Summary:**  
Extends ReSTIR resampling to handle real-time defocus and antialiasing, improving visual quality of depth-of-field effects.

**Background Knowledge Required:**

* ReSTIR (Resampled Importance Sampling for Rendering)
* Real-time rendering and antialiasing methods
* Depth-of-field rendering techniques

**Future Works:**

* Extend to motion blur and complex effects
* Optimize performance on large-scale scenes
* Integration with production renderers
* Apply to AR/VR rendering pipelines

**30. A Fully-correlated Anisotropic Micrograin BSDF Model**

**Summary:**  
Proposes a new anisotropic BSDF model for materials with micrograin structures, capturing fully correlated scattering effects for realism.

**Background Knowledge Required:**

* BSDF models for light-material interaction
* Anisotropic scattering theory
* Microstructure modeling in rendering

**Future Works:**

* Extend to more diverse materials (e.g., fabrics, metals)
* Improve computational performance
* Validate with real-world measurements
* Integrate into standard rendering engines

**31. Haisor: Human-Aware Indoor Scene Optimization via Deep Reinforcement Learning**

**Summary:**  
Uses deep reinforcement learning to optimize indoor layouts by considering human activities and comfort, producing functional and human-friendly designs.

**Background Knowledge Required:**

* Deep reinforcement learning (RL)
* Indoor scene modeling and layout optimization
* Human-centric design principles

**Future Works:**

* Extend to multi-room or large-scale environments
* Incorporate richer human behavior models
* Real-time interactive design tools
* Integration with VR/AR for interior design

**32. Computational Homogenization for Inverse Design of Surface-based Inflatables**

**Summary:**  
Proposes a computational homogenization method to design inflatable structures, enabling precise control of shape and mechanical properties.

**Background Knowledge Required:**

* Computational mechanics and homogenization
* Inverse design methods
* Surface-based geometry modeling

**Future Works:**

* Extend to multi-material inflatables
* Explore large-scale architectural applications
* Optimize fabrication processes
* Integration with interactive design software

**33. Joint Stroke Tracing and Correspondence for 2D Animation**

**Summary:**  
Presents a method to jointly trace and match strokes in 2D animations, helping automate cleanup and correspondence between frames.

**Background Knowledge Required:**

* Stroke-based rendering and animation
* Shape matching and correspondence methods
* 2D animation pipelines

**Future Works:**

* Extend to complex art styles and hand-drawn inputs
* Real-time tools for animators
* Apply to vectorized and hybrid 2D/3D animation
* Improve robustness to noisy input strokes

**34. Specular Polynomials**

**Summary:**  
Introduces a polynomial representation for specular reflection, making specular light transport more efficient and accurate.

**Background Knowledge Required:**

* Specular reflection and light transport
* Polynomial approximations in rendering
* Physically based rendering (PBR)

**Future Works:**

* Extend to more complex material models
* Optimize for production rendering pipelines
* Integration with GPU-based real-time rendering
* Apply in AR/VR lighting simulations

**35. Conditional Mixture Path Guiding for Differentiable Rendering**

**Summary:**  
Proposes a path guiding method that uses conditional mixture models to improve sampling efficiency in differentiable rendering.

**Background Knowledge Required:**

* Differentiable rendering techniques
* Path tracing and path guiding
* Mixture models in probability/statistics

**Future Works:**

* Extend to more general light transport scenarios
* Optimize for real-time differentiable rendering
* Apply to inverse design and material reconstruction
* Integration with ML-based rendering systems

**36. CharacterGen: Efficient 3D Character Generation from Single Images with Multi-View Pose Calibration**

**Summary:**  
Presents a system that generates detailed 3D characters from a single image using pose calibration across multiple views.

**Background Knowledge Required:**

* 3D character modeling and reconstruction
* Pose estimation and calibration
* Neural networks for 3D generation

**Future Works:**

* Extend to full animation-ready characters
* Improve robustness for varied clothing and poses
* Real-time generation for games/VR
* Tools for artists and non-experts

**37. Contact Detection between Curved Fibres: High Order Makes a Difference**

**Summary:**  
Develops a high-order numerical method for detecting contacts between curved fibers, improving realism in fiber and hair simulations.

**Background Knowledge Required:**

* Fiber and hair simulation in graphics
* Contact detection algorithms
* High-order numerical methods

**Future Works:**

* Apply to dense fiber assemblies (cloth, fur)
* Scale up for large simulations
* Improve performance for interactive use
* Extend to multi-material fiber interactions

**38. NeuralTO: Neural Reconstruction and View Synthesis of Translucent Objects**

**Summary:**  
Introduces a neural method to reconstruct and render translucent objects, producing realistic view synthesis from limited input images.

**Background Knowledge Required:**

* Neural rendering and view synthesis
* Translucent material modeling
* Inverse rendering methods

**Future Works:**

* Extend to dynamic/transient translucent materials
* Improve accuracy with sparse data input
* Real-time synthesis for AR/VR
* Apply in material digitization for graphics/film

**39. From Microfacets to Participating Media: A Unified Theory of Light Transport with Stochastic Geometry**

**Summary:**  
Presents a unified framework that connects microfacet reflection models with participating media, using stochastic geometry to describe light transport consistently.

**Background Knowledge Required:**

* Light transport theory
* Microfacet BRDF models
* Participating media (fog, smoke, scattering)

**Future Works:**

* Extend to more complex material types
* Faster computation for real-time rendering
* Apply in production rendering pipelines
* Integration with ML-based light transport models

**40. Target-Aware Image Denoising for Inverse Monte Carlo Rendering**

**Summary:**  
Introduces a denoising method that adapts to the target inverse rendering task, improving accuracy when recovering materials or lighting from noisy data.

**Background Knowledge Required:**

* Monte Carlo rendering and noise issues
* Image denoising with deep learning
* Inverse rendering applications

**Future Works:**

* Extend to dynamic scenes and videos
* Real-time denoising for interactive rendering
* Broader tasks beyond inverse rendering
* Improve robustness under sparse sampling

**41. Creating LEGO Figurines from Single Images**

**Summary:**  
Proposes a method that generates LEGO figurine models directly from a single image, capturing likeness while adapting to LEGO’s shape constraints.

**Background Knowledge Required:**

* 3D reconstruction from single images
* Shape abstraction and simplification
* LEGO-style geometry modeling

**Future Works:**

* Extend to arbitrary LEGO structures
* Real-time generation tools
* Integration with LEGO design software
* Support for animated figurines

**42. Robust Containment Queries over Collections of Rational Parametric Curves via Generalized Winding Numbers**

**Summary:**  
Develops a robust algorithm using generalized winding numbers to check containment of rational parametric curves, useful in CAD and geometry processing.

**Background Knowledge Required:**

* Rational parametric curves in geometry
* Winding numbers for containment queries
* Computational geometry techniques

**Future Works:**

* Extend to 3D parametric surfaces
* Improve scalability for large datasets
* Apply in CAD and manufacturing pipelines
* Integration into real-time geometry engines

**43. Capacitive Touch Sensing on General 3D Surfaces**

**Summary:**  
Introduces a method to enable capacitive touch sensing on arbitrarily curved 3D surfaces, making interactive objects possible beyond flat screens.

**Background Knowledge Required:**

* Capacitive sensing technology
* 3D geometry and surface modeling
* Human–computer interaction (HCI)

**Future Works:**

* Improve accuracy and resolution of sensing
* Scale to large complex surfaces
* Apply in VR/AR devices and smart objects
* Reduce hardware cost for mass production

**44. Theory of Human Tetrachromatic Color Experience and Printing**

**Summary:**  
Explores how humans with four types of cones (tetrachromats) perceive color, and proposes methods for reproducing these experiences in printing.

**Background Knowledge Required:**

* Human color vision models
* Color reproduction and printing technologies
* Psychophysics of perception

**Future Works:**

* Explore personalized printing for varied vision
* Extend to digital display systems
* Deeper study of tetrachromatic perception
* Applications in art, medicine, and accessibility

**45. Intrinsic Image Decomposition via Ordinal Shading**

**Summary:**  
Presents a new method that decomposes images into reflectance and shading using ordinal shading cues, improving intrinsic image estimation.

**Background Knowledge Required:**

* Intrinsic image decomposition
* Shading and reflectance modeling
* Computer vision and image processing

**Future Works:**

* Extend to video sequences
* Improve performance in uncontrolled lighting
* Integrate with inverse rendering pipelines
* Apply in AR/VR relighting tasks

**46. Cybersickness Reduction via Gaze-Contingent Image Deformation**

**Summary:**  
Reduces cybersickness in VR by subtly deforming images based on where users are looking, making motion appear more comfortable.

**Background Knowledge Required:**

* VR rendering and cybersickness causes
* Eye tracking and gaze-contingent rendering
* Human perception in graphics

**Future Works:**

* Test across more VR hardware and content
* Combine with other cybersickness reduction methods
* Real-time optimization for latency-sensitive systems
* Extend to AR experiences

**47. Towards Motion Metamers for Foveated Rendering**

**Summary:**  
Explores motion metamers (perceptually equivalent motions) to improve foveated rendering, maintaining realism while saving computation.

**Background Knowledge Required:**

* Foveated rendering and eye tracking
* Human motion perception models
* Real-time rendering optimization

**Future Works:**

* Validate with broader user studies
* Apply to high-motion VR/AR content
* Extend to other perceptual cues beyond motion
* Integration with real-time game engines

**48. A Heat Method for Generalized Signed Distance**

**Summary:**  
Introduces a heat-based method to compute generalized signed distance functions, making geometry processing tasks like meshing and deformation more efficient.

**Background Knowledge Required:**

* Signed distance functions (SDFs)
* Heat equation in geometry processing
* Mesh representation and deformation

**Future Works:**

* Extend to higher-dimensional problems
* Optimize for large-scale models
* Integration into CAD and simulation software
* Real-time geometry editing applications

**49. Walkin' Robin: Walk on Stars with Robin Boundary Conditions *(Best Paper Award)***

**Summary:**  
Proposes a novel framework using Robin boundary conditions to simulate and analyze random walks on complex domains, with applications to geometry processing and rendering.

**Background Knowledge Required:**

* Random walks and boundary conditions
* Harmonic analysis in geometry
* Numerical PDE methods

**Future Works:**

* Extend to higher-dimensional problems
* Optimize solvers for real-time usage
* Apply in graphics simulations and rendering
* Explore links with physics-based modeling

**50. Repulsive Shells *(Best Paper Award)***

**Summary:**  
Introduces a geometric model of repulsive shells for simulating contact and deformation, enabling robust handling of shell interactions in graphics and physics simulations.

**Background Knowledge Required:**

* Shell geometry and mechanics
* Computational contact modeling
* Differential geometry in graphics

**Future Works:**

* Apply in cloth and soft body simulation
* Improve scalability for large meshes
* Integrate into physics engines
* Extend to biological/medical modeling

**51. Ray Tracing Harmonic Functions *(Best Paper Honorable Mention)***

**Summary:**  
Presents a ray tracing method to evaluate harmonic functions, bridging PDE solutions and rendering techniques for efficient computation.

**Background Knowledge Required:**

* Harmonic functions and Laplace’s equation
* Ray tracing fundamentals
* Numerical PDE methods

**Future Works:**

* Extend to more general PDEs
* Apply in interactive physics-based rendering
* Explore acceleration structures for faster tracing
* Integration with geometry processing pipelines

**52. PEA-PODs: Perceptual Evaluation of Algorithms for Power Optimization in XR Displays**

**Summary:**  
Introduces PEA-PODs, a benchmark for evaluating power optimization methods in XR displays, focusing on perceptual quality and energy savings.

**Background Knowledge Required:**

* XR (VR/AR/MR) display technologies
* Human visual perception
* Power optimization in graphics hardware

**Future Works:**

* Expand benchmark datasets
* Incorporate real-time XR interaction studies
* Apply beyond XR to general display systems
* Explore adaptive optimization strategies

**53. Self-Supervised High Dynamic Range Imaging: What Can Be Learned from a Single 8-bit Video?**

**Summary:**  
Proposes a self-supervised method to reconstruct HDR content from a single standard 8-bit video, removing the need for paired HDR data.

**Background Knowledge Required:**

* High dynamic range (HDR) imaging
* Self-supervised learning methods
* Image-to-image translation

**Future Works:**

* Extend to real-time HDR video streaming
* Apply in consumer devices (phones, cameras)
* Improve robustness to motion and noise
* Explore integration with display rendering pipelines

**54. RGB ↔ X: Image Decomposition and Synthesis Using Material- and Lighting-aware Diffusion Models**

**Summary:**  
Proposes a diffusion-based model that decomposes images into material and lighting components, enabling realistic editing, relighting, and synthesis.

**Background Knowledge Required:**

* Diffusion models
* Material and lighting models in graphics
* Image decomposition techniques

**Future Works:**

* Real-time material editing tools
* Expansion to dynamic scenes/videos
* Better generalization to diverse materials
* Integration with 3D editing pipelines

**55. Blue Noise for Diffusion Models**

**Summary:**  
Introduces blue-noise sampling strategies to improve the efficiency and quality of diffusion models, reducing artifacts and speeding up convergence.

**Background Knowledge Required:**

* Diffusion models in generative AI
* Sampling theory (blue noise, low-discrepancy)
* Image synthesis and denoising

**Future Works:**

* Apply to large-scale text-to-image models
* Extend to video and 3D generation
* Explore adaptive noise schedules
* Optimize for mobile/edge devices

**56. Navigation-Driven Approximate Convex Decomposition**

**Summary:**  
Presents a method to decompose 3D environments into approximate convex regions guided by navigation needs, improving path planning and simulation efficiency.

**Background Knowledge Required:**

* Convex decomposition in geometry processing
* Pathfinding and navigation meshes
* Computational geometry

**Future Works:**

* Extend to large-scale game environments
* Real-time convex decomposition updates
* Integration with robotics navigation
* Use in VR/AR interaction spaces

**57. Primal–Dual Non-Smooth Friction for Rigid Body Animation**

**Summary:**  
Develops a primal–dual algorithm to simulate rigid bodies with non-smooth friction, improving physical realism in animations.

**Background Knowledge Required:**

* Rigid body dynamics
* Friction modeling in physics engines
* Optimization methods (primal–dual)

**Future Works:**

* Apply in game physics engines
* Improve computational speed for real-time use
* Extend to deformable and soft bodies
* Explore robotics and haptics applications

**58. Quad-Optimized Low-Discrepancy Sequences**

**Summary:**  
Proposes optimized quasi-random sampling sequences tailored for quadrilateral domains, improving rendering and integration tasks.

**Background Knowledge Required:**

* Low-discrepancy sampling
* Monte Carlo rendering
* Numerical integration methods

**Future Works:**

* Apply to global illumination rendering
* Extend to higher-dimensional sampling
* Optimize for GPU-based pipelines
* Combine with adaptive sampling strategies

**59. Mob-FGSR: Frame Generation and Super Resolution for Mobile Real-Time Rendering**

**Summary:**  
Introduces a mobile-friendly framework for real-time rendering that combines frame generation and super-resolution to boost visual quality and performance.

**Background Knowledge Required:**

* Real-time rendering techniques
* Frame interpolation and super-resolution
* Mobile GPU architectures

**Future Works:**

* Extend to cloud gaming and XR devices
* Improve temporal stability
* Explore energy-efficient implementations
* Generalize to high-motion 3D content

**60. Rip-NeRF: Anti-aliasing Radiance Fields with Ripmap-Encoded Platonic Solids**

**Summary:**  
Proposes Rip-NeRF, an anti-aliasing method for radiance fields using ripmap-encoded Platonic solids to improve rendering quality at multiple resolutions.

**Background Knowledge Required:**

* Neural Radiance Fields (NeRF)
* Anti-aliasing techniques
* Multiresolution texture encoding

**Future Works:**

* Apply to real-time NeRF rendering
* Extend to dynamic/animated NeRFs
* Optimize for large-scale scene rendering
* Explore hybrid methods with classical mipmaps

**61. Velocity-Based Monte Carlo Fluids**

**Summary:**  
Introduces a Monte Carlo method for fluid simulation driven by velocity sampling, offering improved accuracy and reduced noise in fluid animations.

**Background Knowledge Required:**

* Fluid simulation in graphics
* Monte Carlo sampling methods
* Numerical fluid dynamics

**Future Works:**

* Apply in large-scale water and smoke effects
* Optimize for GPU and real-time use
* Extend to multiphase and turbulent fluids
* Integrate with hybrid particle-grid simulations

**62. A Differential Monte Carlo Solver For the Poisson Equation**

**Summary:**  
Presents a Monte Carlo–based solver for the Poisson equation that supports differentiable computations, useful for inverse problems and rendering applications.

**Background Knowledge Required:**

* Monte Carlo methods
* Partial differential equations (Poisson equation)
* Differentiable rendering concepts

**Future Works:**

* Apply to broader PDEs beyond Poisson
* Improve computational efficiency
* Integrate with physics-informed neural networks
* Use in real-time rendering and simulation

**63. NeRF As A Non-Distant Environment Emitter in Physics-Based Inverse Rendering**

**Summary:**  
Extends NeRF to act as a non-distant environment light source, enabling more accurate physics-based inverse rendering.

**Background Knowledge Required:**

* Neural Radiance Fields (NeRF)
* Inverse rendering methods
* Lighting and global illumination models

**Future Works:**

* Apply to mixed reality lighting estimation
* Improve computational efficiency
* Extend to dynamic and time-varying lighting
* Integrate with material estimation methods

**64. Path-Space Differentiable Rendering of Implicit Surfaces**

**Summary:**  
Develops a differentiable rendering framework for implicit surfaces directly in path space, improving gradient-based optimization tasks.

**Background Knowledge Required:**

* Implicit surface representations
* Path tracing and rendering equations
* Differentiable rendering

**Future Works:**

* Apply to shape reconstruction and optimization
* Extend to real-time differentiable rendering
* Combine with NeRF-like implicit fields
* Explore material and texture optimization

**65. Practical Error Estimation for Denoised Monte Carlo Image Synthesis**

**Summary:**  
Proposes a practical method to estimate error in denoised Monte Carlo renderings, improving reliability and quality assessment.

**Background Knowledge Required:**

* Monte Carlo rendering
* Image denoising techniques
* Error estimation methods

**Future Works:**

* Apply to real-time denoising systems
* Extend to adaptive sampling and rendering pipelines
* Improve error metrics for perceptual quality
* Use in production rendering tools

**66. Neural Geometry Fields For Meshes**

**Summary:**  
Introduces neural geometry fields that model mesh structures, enabling new forms of editing, reconstruction, and representation learning.

**Background Knowledge Required:**

* Mesh representation in computer graphics
* Neural implicit representations
* Geometry processing

**Future Works:**

* Apply to 3D content creation tools
* Improve generalization to complex topologies
* Integrate with simulation and animation
* Explore hybrid mesh–implicit models

**67. A Construct-Optimize Approach to Sparse View Synthesis without Camera Pose**

**Summary:**  
Proposes a framework for synthesizing 3D views from sparse input images without requiring explicit camera poses.

**Background Knowledge Required:**

* View synthesis and neural rendering
* Structure-from-motion concepts
* Pose-free learning methods

**Future Works:**

* Apply to casual photo-to-3D reconstruction
* Improve quality under extreme sparsity
* Extend to video and dynamic scenes
* Use in VR/AR applications

**68. N-BVH: Neural Ray Queries with Bounding Volume Hierarchies**

**Summary:**  
Combines neural networks with BVH (bounding volume hierarchies) for efficient ray queries, accelerating neural rendering pipelines.

**Background Knowledge Required:**

* Ray tracing and BVHs
* Neural networks in graphics
* Rendering acceleration structures

**Future Works:**

* Apply to real-time neural rendering
* Extend to dynamic and deformable scenes
* Optimize for large-scale path tracing
* Integration with neural radiance fields

**69. Self-Supervised Video Defocus Deblurring with Atlas Learning**

**Summary:**  
Introduces a self-supervised framework to deblur defocused video using atlas learning, removing blur without ground-truth supervision.

**Background Knowledge Required:**

* Video deblurring and defocus models
* Self-supervised learning
* Deep neural networks for image restoration

**Future Works:**

* Extend to real-time video processing
* Apply to consumer video and mobile devices
* Improve generalization across camera types
* Integrate with video enhancement pipelines

**70. Diffusion Texture Painting**

**Summary:**  
Applies diffusion models for texture painting, enabling high-quality, controllable texture generation for 3D assets.

**Background Knowledge Required:**

* Diffusion models
* Texture synthesis in computer graphics
* 3D asset creation pipelines

**Future Works:**

* Real-time interactive texture editing
* Apply to procedural material generation
* Extend to multi-resolution texture synthesis
* Integration with game and film production tools

**71. Neural Bounding**

**Summary:**  
Proposes a neural approach for bounding in geometry and graphics, improving efficiency and accuracy in spatial queries like collision detection or rendering acceleration.

**Background Knowledge Required:**

* Bounding volume hierarchies (BVH)
* Neural networks in geometry processing
* Computational geometry fundamentals

**Future Works:**

* Extend to dynamic and deformable objects
* Apply to large-scale simulations and real-time rendering
* Explore hybrid neural–traditional bounding strategies
* Optimize for mobile and XR platforms

**72. Fabricable 3D Wire Art**

**Summary:**  
Presents methods to generate 3D wire art that is physically fabricable while preserving artistic style and structural feasibility.

**Background Knowledge Required:**

* Geometry processing
* Fabrication constraints in computational design
* 3D art and aesthetics in computer graphics

**Future Works:**

* Support interactive artist-driven design
* Extend to mixed-material sculptures
* Integrate with automated fabrication machines
* Apply to educational or consumer creative tools

**73. N-Dimensional Gaussians for Fitting of High Dimensional Functions**

**Summary:**  
Introduces Gaussian-based representations to approximate high-dimensional functions efficiently, useful for rendering and simulation.

**Background Knowledge Required:**

* Multivariate Gaussian distributions
* Function approximation in high dimensions
* Rendering and optimization techniques

**Future Works:**

* Apply to neural rendering acceleration
* Improve scalability to ultra-high dimensions
* Explore adaptive Gaussian mixtures
* Integrate into Monte Carlo estimators

**74. SMEAR: Stylized Motion Exaggeration with ARt-direction**

**Summary:**  
Presents a framework for exaggerating motion in stylized animation, allowing art-directed expressive control.

**Background Knowledge Required:**

* Character animation techniques
* Stylization in computer graphics
* Motion exaggeration principles

**Future Works:**

* Integrate with game engines for real-time stylization
* Extend to multi-character interactions
* Apply to AR/VR immersive storytelling
* Explore AI-driven art-direction tools

**75. Recompose Grammars for Procedural Architecture**

**Summary:**  
Proposes recomposable grammar rules for procedural modeling of architecture, enabling greater flexibility and variety.

**Background Knowledge Required:**

* Procedural modeling (shape grammars)
* Architectural design in graphics
* Rule-based generation systems

**Future Works:**

* Apply to interactive city/level design tools
* Extend to interior architecture and furniture
* Combine with diffusion-based generative models
* Support multi-user collaborative modeling

**76. ThemeStation: Generating Theme-Aware 3D Assets from Few Exemplars**

**Summary:**  
Uses generative models to produce 3D assets consistent with a given “theme,” based on few example inputs.

**Background Knowledge Required:**

* Generative modeling for 3D assets
* Style and theme transfer in graphics
* Few-shot learning

**Future Works:**

* Expand to large-scale asset libraries for games/VR
* Apply to personalized content generation
* Extend to multi-modal inputs (text + images)
* Improve consistency across large scenes

**77. Taming Diffusion Probabilistic Models for Character Control**

**Summary:**  
Adapts diffusion probabilistic models to generate and control character animations with precision and realism.

**Background Knowledge Required:**

* Diffusion models
* Character animation and motion capture
* Control and constraints in generative models

**Future Works:**

* Apply to interactive game characters
* Extend to full-body physics-driven motions
* Improve controllability with natural language inputs
* Real-time deployment for VR/AR avatars

**78. A Realistic Multi-scale Surface-based Cloth Appearance Model**

**Summary:**  
Develops a multi-scale model for simulating and rendering realistic cloth appearance, capturing fine surface-level details.

**Background Knowledge Required:**

* Cloth simulation and rendering
* Microfacet and multi-scale appearance models
* Material capture methods

**Future Works:**

* Apply to real-time fashion visualization
* Extend to physically fabricable textiles
* Improve efficiency for gaming applications
* Combine with diffusion-based material synthesis

**79. Into the Portal: Directable Fractal Self-Similarity**

**Summary:**  
Introduces directable fractal-based patterns for visual effects, allowing control over self-similar fractal behaviors.

**Background Knowledge Required:**

* Fractals and self-similarity in mathematics
* Procedural content generation
* Visual effects pipelines

**Future Works:**

* Apply to stylized animation and VFX
* Extend to real-time fractal worlds in VR
* Integrate into game engine procedural shaders
* Combine with diffusion models for hybrid styles

**80. Singular Foliations for Knit Graph Design**

**Summary:**  
Uses singular foliations to design knit graphs, enabling complex and fabricable knitted structures.

**Background Knowledge Required:**

* Knit graph structures
* Foliation in geometry and topology
* Computational fabrication

**Future Works:**

* Apply to industrial textile manufacturing
* Extend to 4D printed knittable materials
* Support artist-driven knit pattern exploration
* Integrate into fashion and apparel design pipelines

**81. Neural-Assisted Homogenization of Yarn-Level Cloth**

**Summary:**  
Presents a neural-assisted method to approximate yarn-level cloth into homogenized models, balancing realism with simulation efficiency.

**Background Knowledge Required:**

* Cloth simulation and yarn-level modeling
* Neural network approximation techniques
* Homogenization methods in material science

**Future Works:**

* Extend to dynamic wear and tear effects
* Apply to fashion visualization and VR try-on
* Improve real-time performance in games
* Hybrid models combining yarn + macro simulation

**82. Dynamic 3D Gaussian Prediction for Motion Extrapolation and Free View Synthesis**

**Summary:**  
Uses dynamic 3D Gaussians to predict motion and enable free-viewpoint video synthesis with temporal coherence.

**Background Knowledge Required:**

* 3D Gaussian splatting
* Motion prediction/extrapolation
* Free-viewpoint rendering

**Future Works:**

* Extend to large-scale scene capture
* Improve temporal consistency for long sequences
* Apply to immersive VR/AR telepresence
* Integrate with NeRF-based pipelines

**83. Soft Pneumatic Actuator Design using Differentiable Simulation**

**Summary:**  
Applies differentiable simulation to optimize the design of soft pneumatic actuators for robotics.

**Background Knowledge Required:**

* Soft robotics and pneumatic actuators
* Differentiable physics simulation
* Optimization techniques

**Future Works:**

* Automate soft robot design pipelines
* Extend to multi-material actuators
* Apply in medical robotics and wearables
* Real-time feedback-driven actuator design

**84. IntrinsicDiffusion: Joint Intrinsic Layers from Latent Diffusion Models**

**Summary:**  
Uses diffusion models to decompose images into intrinsic layers (albedo, shading, etc.) for better editing and relighting.

**Background Knowledge Required:**

* Intrinsic image decomposition
* Latent diffusion models
* Image relighting/editing

**Future Works:**

* Improve decomposition accuracy for real-world photos
* Extend to video-level consistency
* Combine with generative editing tools
* Apply to AR scene editing

**85. Modelling a Feather as a Strongly Anisotropic Elastic Shell**

**Summary:**  
Proposes a physics-based model treating feathers as anisotropic elastic shells, enabling realistic feather simulation.

**Background Knowledge Required:**

* Elastic shell modeling
* Anisotropy in material simulation
* Biological structure modeling

**Future Works:**

* Apply to bird flight simulation
* Extend to wearable feathered costumes/props
* Integrate into movie/game production pipelines
* Explore hybrid feather–fur modeling

**86. Object-level Scene Deocclusion**

**Summary:**  
Restores occluded parts of a scene at the object level, generating plausible completions with structural awareness.

**Background Knowledge Required:**

* Scene reconstruction and completion
* Object-level recognition
* Deep generative models

**Future Works:**

* Apply to AR/VR scene editing
* Extend to video-based deocclusion
* Improve geometric consistency with 3D scans
* Interactive user-guided deocclusion

**87. CNS-Edit: 3D Shape Editing via Coupled Neural Shape Optimization**

**Summary:**  
Introduces a framework for editing 3D shapes by coupling neural representations with optimization for high-quality results.

**Background Knowledge Required:**

* Neural implicit 3D representations
* Shape optimization methods
* 3D editing workflows

**Future Works:**

* Apply to large-scale CAD model editing
* Integrate into AR/VR creative tools
* Support real-time interactive editing
* Extend to texture and material editing

**88. Ciallo: GPU-Accelerated Rendering of Vector Brush Strokes**

**Summary:**  
Presents a GPU-accelerated rendering method for vector brush strokes, achieving fast and scalable digital painting effects.

**Background Knowledge Required:**

* Vector graphics and brush stroke rendering
* GPU acceleration techniques
* Real-time graphics pipelines

**Future Works:**

* Extend to mobile/tablet creative apps
* Support stylized and 3D-aware brush strokes
* Apply to animation and illustration tools
* Integrate with AI-assisted painting systems

**89. DiLightNet: Fine-grained Lighting Control for Diffusion-based Image Generation**

**Summary:**  
A framework that enables precise lighting control in diffusion-based image generation, allowing users to modify illumination while preserving realism.

**Background Knowledge Required:**

* Diffusion models for image synthesis
* Physics of light transport & shading
* Controllable image generation techniques

**Future Works:**

* Extend to video with temporal lighting consistency
* Integrate into creative tools (Photoshop, Blender)
* Explore user-guided natural language lighting control
* Combine with 3D scene editing pipelines

**90. Efficient Position-Based Deformable Colon Modeling for Endoscopic Procedures Simulation**

**Summary:**  
Proposes a fast and accurate colon modeling approach for simulating endoscopic procedures using position-based deformable models.

**Background Knowledge Required:**

* Medical simulation and VR training
* Position-based dynamics (PBD)
* Biomechanical modeling of soft tissues

**Future Works:**

* Extend to other organ/tissue simulations
* Use in VR-based surgical training platforms
* Improve realism with patient-specific data
* Real-time haptic feedback integration

**91. 4D-Rotor Gaussian Splatting: Towards Efficient Novel View Synthesis for Dynamic Scenes**

**Summary:**  
Extends Gaussian splatting to 4D (space + time), enabling efficient rendering and view synthesis of dynamic scenes.

**Background Knowledge Required:**

* Gaussian splatting and radiance fields
* Dynamic scene reconstruction
* Novel view synthesis

**Future Works:**

* Real-time VR/AR telepresence
* Large-scale outdoor dynamic scene rendering
* Integration with NeRF pipelines
* Long-term motion-consistent synthesis

**92. Minkowski Penalties: Robust Differentiable Constraint Enforcement for Vector Graphics**

**Summary:**  
Introduces Minkowski penalties for enforcing geometric constraints robustly in differentiable vector graphics optimization.

**Background Knowledge Required:**

* Vector graphics representation
* Differentiable rendering/optimization
* Minkowski geometry concepts

**Future Works:**

* Apply to scalable design optimization tools
* Extend to 3D modeling with constraints
* Improve efficiency for interactive editing
* Combine with neural design systems

**Easier Papers for You (Good Fit)**

1. **DiLightNet (89)** – Lighting control for diffusion models → diffusion + controllable generative AI.
2. **4D-Rotor Gaussian Splatting (91)** – Extends splatting to dynamic scenes → NeRF + Gaussian splatting (lots of data structure & algo flavor).
3. **N-BVH: Neural ray queries with bounding volume hierarchies (84)** – Strong DSA + ML (BVH acceleration + neural queries).
4. **Neural Geometry Fields for Meshes (83)** – Neural implicit geometry representations (neural fields + geometry).
5. **A Construct-Optimize Approach to Sparse View Synthesis without Camera Pose (83)** – Generative + optimization, fits ML.
6. **Rip-NeRF: Anti-aliasing Radiance Fields (79)** – NeRF-based, algorithm-heavy.
7. **Blue Noise for Diffusion Models (77)** – Algorithmic + diffusion models (both your strengths).
8. **Diffusion Texture Painting (86)** – Diffusion-based creative tool → ML-heavy.
9. **RGB ↔ X: Material- and Lighting-aware Diffusion (76)** – Diffusion + image decomposition (AI-heavy).
10. **Dynamic 3D Gaussian Prediction for Motion Extrapolation (93)** – NeRF/Gaussian splatting + ML, close to 91.
11. **CNS-Edit: 3D Shape Editing via Coupled Neural Shape Optimization (94)** – Neural optimization + geometry.
12. **Taming Diffusion Probabilistic Models for Character Control (87)** – Diffusion + control (AI-heavy).