Light-Field Wave

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Abstract

A light-field wave is defined as a time-evolving radiative field within a bounded region, characterized by the angular, spectral, and intensity distribution of light as it undergoes propagation, reflection, and transformation under geometric constraints. This paper introduces the light-field wave as a new conceptual primitive for studying recursive radiative behavior.

1. Definition

A light-field wave is the function

[L(\theta, \phi, \lambda, t)]

representing radiance across all directions and wavelengths as a function of time. It is not a static field but a dynamical radiance distribution shaped by geometry, reflectance, and perturbation.

2. Field Structure

The structure of the wave is determined by:

- boundary geometry and symmetry group (G)
- reflectance properties (R(\lambda))
- emitter spectrum and temporal pattern
- perturbations (motion, asymmetry, noise)

These factors define the transformation operator that governs field evolution.

3. Wave Evolution

The field evolves according to

[L(t+\Delta t) = \mathcal{W}(L(t), E(t), G)]

where (\mathcal{W}) encodes propagation, reflection, and recursive interaction. The wave may exhibit standing-wave behavior, driven responses, or chaotic evolution depending on cavity symmetry and perturbation.

4. Distinction from Classical Radiance Fields

Traditional radiance fields assume static or externally driven illumination. A light-field wave is internally driven, recursively reinforced, and geometry-constrained. It is a dynamical object, not a snapshot.

5. Observables

Observable properties include:

- symmetry-dependent structure
- recursive amplification
- sensitivity to perturbation
- temporal coherence or decoherence
- emergent patterns

These observables make the light-field wave a useful probe of geometry and recursion.

6. Purpose

The light-field wave serves as a new conceptual tool for studying recursive radiative behavior, symmetry effects, and field evolution in closed systems. It provides a visual, measurable, and teachable mechanism for understanding recursion in physical systems.