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Optimization of light distribution of lenses for Li-Fi luminaires: comparative study of models LIA and LIB with photometric calculations

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INTRODUCTION & AIM

Li-Fi (Light Fidelity) technology is a promising method for wireless data transmission using visible light. The performance of a Li-Fi system depends not only on the light source's modulation but also on secondary optics. Spatial light distribution is critical for coverage uniformity and communication stability.

METHOD

This paper presents a comparative study of two lenses—LiA and LiB—using Techno Team 3D software. The goal was to evaluate how geometric modifications affect photometric properties and identify the best configuration for a Li-Fi luminaire requiring wider angles and uniform light distribution.

RESULTS & DISCUSSION

1. Light Distribution Analysis of Lens LiA
Simulation results show that lens LiA has a maximum luminous intensity of 4689 cd. The full width at half maximum (FWHM) corresponds to a beam angle of approximately 60°. The estimated luminous flux is around 2755 lm. LiA produces a concentrated beam with distinct high-intensity zones. While suitable for directional lighting, this pattern limits the stable signal reception area and leads to uneven coverage—undesirable for indoor optical wireless communication.

2. Light Distribution Analysis of Lens LiB
After geometric modification, lens LiB shows a maximum intensity of 4304 cd. The beam angle at half maximum increases to about 80°. Simulation results indicate a wider light diffusion and smoother intensity distribution. Peak values are reduced, and luminous flux is spread more evenly across the working area. This is especially beneficial for Li-Fi luminaires, as a larger illumination area improves channel accessibility for users.

CONCLUSION

An additional advantage of lens LiB is the reduced contrast between the center and periphery of the light spot. A more homogeneous illumination field minimizes the risk of "dead zones" and enhances communication reliability. The optical redesign thus yields parameters better suited for advanced Li-Fi applications.

For Li-Fi systems, uniform light distribution is more critical than high directionality. Expanding the emission angle increases coverage and reduces the likelihood of insufficient signal zones. Calculated data confirm that transitioning from LiA to LiB broadens the solid angle and provides more homogeneous illumination, making lens LiB the preferred choice for integration into Li-Fi lighting systems.

FUTURE WORK / REFERENCES

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