TAYLORING LIGHT BEAMS:

HOW TO DESIGN LENSES TO MANIPULE THE EMISSION OF LEDS

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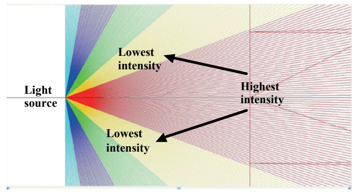
INTRODUCTION

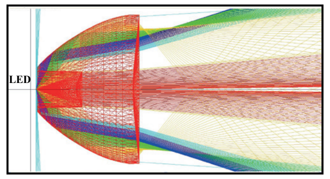
When I was starting this paper on my working table, I realized that it was not well lit and that I needed a lamp to see properly. So instead of buying a new one and forget it, why not trying know how it is made to light exactly where I need? And this is what I did. Nowadays, LEDs can be used to make most light-emitting items. The external structure is almost the same: they have a support, an electrical circuit and one or more LEDs. But, what really makes them different is where its emitted light goes. And devices which do this function are lenses. So to make the lamp the most important was to make the correct lens Then I had clear my necessity: I wanted to light my work place properly, so I wanted to make a lens for my lamp which concentrates light but not only on one point, want it in a confined space.

MATERIALS AND METHODS

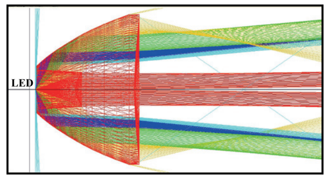
Before starting to design a lens it is convenient to generate a range of light beams into a plane with a difference of 0,5° between every beam in order to compute how light spreads.

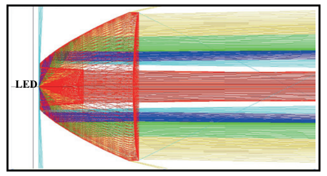


Before guiding light rays where we want them to go, we have to collimate them. This means that we have to put them on the same direction with our lens We started drawing our lens modifying its different walls in order to lead beams where we wanted them to go. Having done that, what we had to do was to make them collimate; the lens we were going to make mostly had a hemispherical shape with a hole where is supposed to be spherical. This hole must have standard dimensions because the LED will be placed there, and for all kinds of lenses.

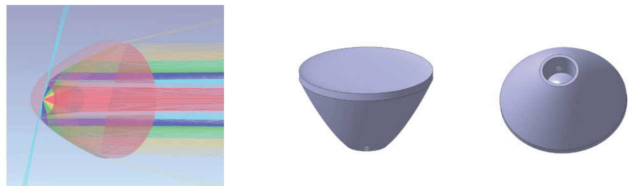


When we had put our prototype into the range of light beams, we could see that it did not do what we expected because almost none of the rays went in a straight line. That meant that we had to focus on some particular rays, studied its behavior and started modifying the lens

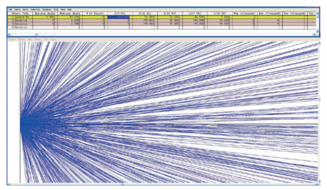


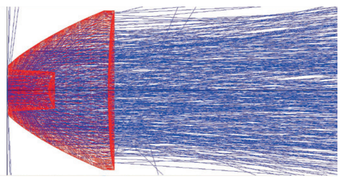


Finally, after ninety-five modifications of the first lens we were able to put all beams in the direction which we wanted.



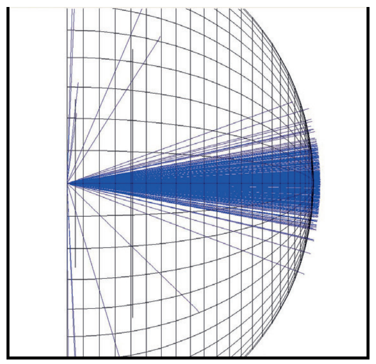
Once we had finished the designing process, what we had to do next was a more reliable simulation where we were able to show in a precise way which the functioning of our lens will be. To do it, we used a program which allowed us to simulate with a large amount of rays (the estimated quantity that a LED emits) instead of the 1,000 used during the desig



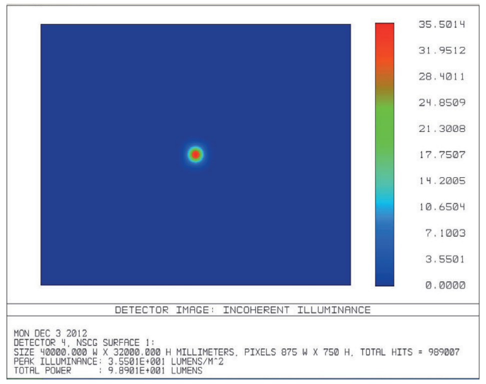


Now, we are ready to create any kind of lens for each specific need.

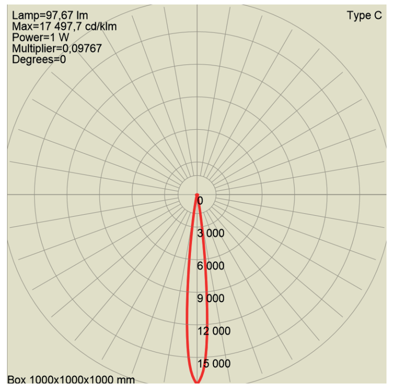
RESULTS



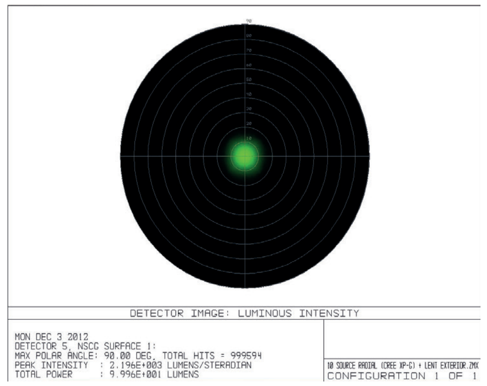
View of the light dispersion when it passes through the lens.



Graphic made by the simulator which shows light distribution in different colours depending on its intensity.



Dispersion's graphic in polar mode



Graphic in polar mode given by the simulator which shows the intensity produced by the LED with the lens. It measures the light projected in a hemisphere, instead of on a plane

CONCLUSION

Writing this paper has helped me to answer some of the questions I asked myself before starting it; especially how things as small as LEDs, which emit light in all directions, could properly light, for example, my workplace. I now know that this is possible thanks to lenses.

I have also learnt the difference between diferent lenses and the process of making them.

Following this experience, I am now even more convinced that lenses and LEDs are not only the future of lighting but are also the present, because the technology is available for developing their full potential. It is unbelievable how much energy can be saved.

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