



UNIVERSITÄT ZU LÜBECK



**Program: Biomedical Engineering**

## **Master's Thesis**

**Title:**

**Development of a colour-temperature-adjustable surgery lamp by means of multi-chip LEDs for a high colour rendering index**

**Summary:**

During surgeries, different organs and tissues need to be differentiated by their various reddish colour shades. Here, surgery lamps providing only one correlated colour temperature (CCT) are not sufficient. Thus, in this work an innovative prototype of a surgery lamp has been developed, allowing the adjustment of CCTs from 3700 K to 6500 K. For this laboratory prototype coloured multi-chip LEDs were implemented to achieve a high colour rendering index (CRI) as well as high scores of the colour quality scale (CQS). Even with commercially available (not optimal fitting) secondary optics, very high CRI (up to 98 for Ra and R9) and CQS (up to 99 for Qa and Q1) scores were achieved for all tested CCT configurations. To achieve a more homogeneous light field with those multi-chip LEDs, further, an optimized secondary optic has been designed. This secondary optic allows an internal colour-mixing rather than generating an overlapping of the different light beams. Such internal colour-mixing is achieved by means of a homogenization rod in combination with a total internal reflection (TIR) optic. Here, one out of four simulated concepts was rapid-prototyped via 3D-printing.

Author: Jonas Nolte (B. Sc.)

Date of completion: 18.08.2014