# Influence of pump beam shaping and noise on performance of direct diode-pumped Ti:sapphire laser

**Muhammad Tahir Jamal**[1], **Anders Kragh Hansen**[2], **Peter Eskil Andersen**[1], **Ole Bjarlin Jensen**[2]

1. *DTU Health Tech, Technical University of Denmark, Frederiksborgvej 399, 4000 Roskilde, Denmark*
2. *DTU Fotonik, Technical University of Denmark, Frederiksborgvej 399, 4000 Roskilde, Denmark*

**Abstract 1:** (97 words, max 100 words)
An ultrafast titanium sapphire (Ti:S) laser equipped with a compact and efficient pump laser is in high demand in many biomedical applications. Recently developed high power visible laser diodes are the cost-effective alternate option to commercial diode-pumped-solid-state lasers for pumping Ti:S. We used two spectrally combined direct laser diodes (LDs) to pump a Ti:S oscillator and demonstrated stable Kerr-lens mode-locking with an average output power of 190 mW. We have carefully studied and realized the beam shaping of both LDs to achieve the maximum pumping efficiency. Furthermore, we have analyzed the noise performance of the overall system.

**Abstract 2:** (206 words, max 250 words)
Complex, bulky and expensive commercial pump sources for ultrafast titanium sapphire (Ti:S) lasers prevent its widespread use for biomedical applications in clinical environment. Recent development in the direct laser diodes' (LD) power per emitter in the wavelength region (488-520 nm) suitable for pumping Ti:S laser has presented a very attractive opportunity to develop a very compact, inexpensive and efficient diode laser pump source. The far-from-diffraction limited beam quality of these LDs makes it quite challenging to achieve stable high powers in Kerr-lens mode-locked (KLM) operation of Ti:S lasers. We carefully studied and realized the beam shaping of two LD's emitting at 488nm and 517nm to achieve the optimum mode coupling to the resonator mode in the Ti:S crystal. An average output power of 190 mW in stable KLM operation and 270 mW in CW operation of the Ti:S laser was demonstrated with the spectrally combined LD's pump module emitting 2.9 W in total. The noise performance of the Ti:Sa laser output was studied in detail, which is a very crucial parameter for biomedical imaging applications to achieve higher resolution and better contrast. The overall system performance is compared to a commercial diode-pumped solid-state laser (Verdi). This investigation may lead to better performance of diode-pumped Ti:S lasers.