# METHOD AND HYBRID BEAM COMBINING SYSTEM TO OBTAIN HIGH POWER LASER BEAM

## IITM Technology Available for Licensing

### Problem Statement

- Individual laser emitters and single-mode fiber lasers face power limitations due to thermal and nonlinear effects, restricting their effectiveness for Directed Energy (DE) applications.
- Coherent beam combining (CBC) of multiple laser modules is needed to achieve high power levels, but it faces issues like stringent requirements on laser parameters, nonlinear optical effects, and practical difficulties in phase noise compensation and beam quality.
- Phase synchronization time and the number of iterations required increase with more elements, complicating the system's scalability and affecting the overall beam quality and efficiency.

### TRL (Technology Readiness Level)

**TRL - 5: Technology validated in relevant environment.**

### Technology Category/ Market

**Category - High-Power Laser Systems**
**Applications** - Industrial Manufacturing, Laser Surgery and Treatments, Non-Invasive Diagnostics
**Industry- Precision Cutting and Welding, Advanced Photonic Components**

**Market -** Global High Power Laser Systems Market is expected to register a **CAGR of 7.1%** during the forecast period (2022-2027).

### Research Lab

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### Intellectual Property

- IITM IDF Ref. **2058**
- **IN 507846 - Patent Granted**

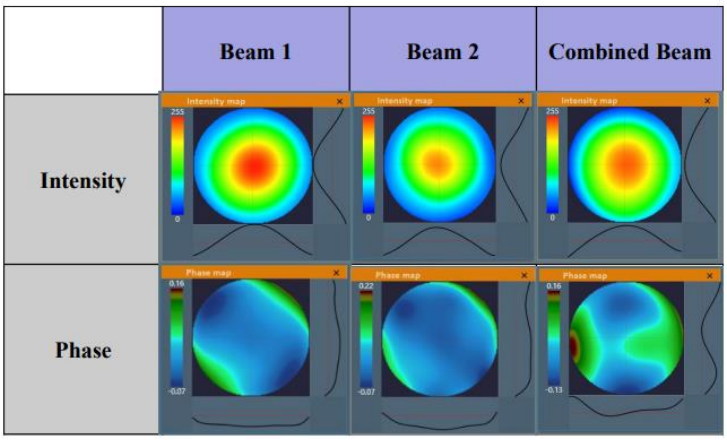


**FIG. 1. illustrates intensity profiles and phase maps of the high power laser beam generated for the high-power laser beam generated by the hybrid beam combining system.**

### Technology

1. **The system utilizes multiple master oscillators to split each laser beam into two beams, amplifying them separately and coherently combining them through multiple stages to achieve high-power output.**
2. **It employs feedback controllers and beam quality monitors for phase synchronization and quality maintenance, utilizing machine learning techniques like Recurrent Neural Networks (RNNs) to optimize performance.**
3. **The system can produce a high power composite laser beam, ranging from 10 Watts to several MegaWatts, by polarization multiplexing and spectrally combining the coherently combined beams from each laser.**

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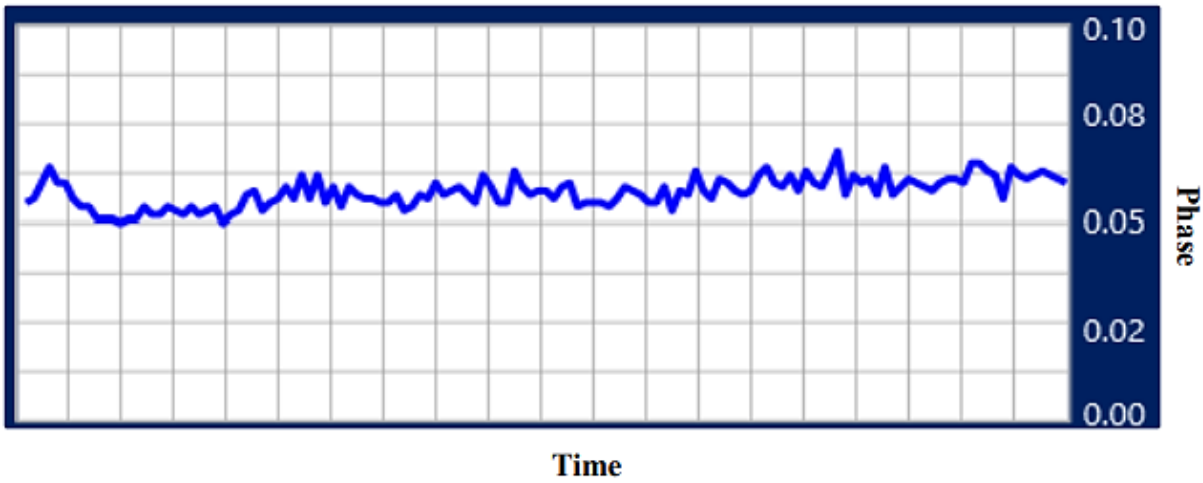


**FIG. 2. A graphical representation illustrating a time trace of the total wavefront error (RMS) of the high-power laser beam obtained from the hybrid beam combining system.**

## Key Features / Value Proposition

| | |
|---|---|
| **1. Enhanced Power Output** | **Achieves high-power laser beams suitable for demanding applications, ranging from 10 Watts to several MegaWatts.** |
| **2. Superior Beam Quality** | **Utilizes advanced phase synchronization and feedback control systems to maintain optimal beam quality and minimize power losses.** |
| **3. Scalability and Flexibility** | **Scalable architecture allows for easy integration and adaptation to various industrial, defense, and research applications.** |
| **4. Advanced Control with AI** | **Incorporates machine learning techniques, such as Recurrent Neural Networks (RNNs), for improved phase synchronization and system optimization.** |

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