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Experimental study on beam shaping in a reduced-scale relay mirror system

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Abstract Improving power coupling efficiency of beam uplink propagation in a relay mirror system is under extensive research in recent years. A typical model of the relay mirror system is established and theory of beam shaping used to improve power coupling efficiency of the relay mirror system is analyzed in detail. A reduced-scale experimental relay mirror system is founded, which has the same Fresnel number as uplink propagation in the relay mirror system with 1.0 m-caliber transmitter and 30 km propagation distance. Phase distribution of the source is optimized by using the stochastic parallel gradient descent algorithm. The experimental results showed that power coupling efficiency of uplink propagation in the reduced-scale relay mirror system was improved from 72.67 to 87.88 % by beam shaping and the bucket power proportion in 5 pixels at the target was improved from 45.49 to 52.78 %.

Keywords Relay mirror system · Power coupling efficiency · Uplink propagation · Beam shaping

1 Introduction

The relay mirror technique is an important system combat concept under extensive research in recent years (Hartman et al. 2002; Johnson 2006; Leonard 1998). The relay mirror system can enlarger laser system combat scope, lower tracking bandwidth, longer integration time and lower laser illuminator power (Leonard 1998; Glaros 2004). The United States have carried out a set of experiments since the 1990s (Glaros 2004; Relay Mirror Experiment 2004; St.Louis 2006). In 2006, Boeing and the Air Force Research Laboratory demonstrated

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