Reinforcement Learning for Coherent Pulse Stacking

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Abstract: Coherent Pulse Stacking (CPS) is a temporal multiplexing technique, which can stack a burst of pulses coherently into one beyond the limit of a single amplifier. CPS technique is achieved by adjusting phases of input pulses and cavity phases to combine them. In this study, we will use reinforcement learning (RL) to learn the proper phases actions strategy in this CPS system, starting from random initial phases. To our knowledge, we are the first group to report using reinforcement learning for pulse stacking.

1 Introduction

High energy lasers have attracted a lot of attention and interest due to their application in welding, material cutting and plasma weak field acceleration. To increase peak power of laser pulses, Chirped-Pulse Amplification (CPA) was developed in 1985 [1]. However, CPA focused on amplifying a single pulse and hence its performance was limited by capacity of optical components. One way to circumvent this limitation is to increase peak power by combining multiple pulses. Coherent Pulse Stacking (CPS) is a temporal multiplexing technique, which can stack a burst of pulses coherently into one pulse using a series of GTI cavities if the input pulses have desirable phases (Figure 1).

However, analytically finding proper phases for pulse train is difficult due to complexity of CPS system. To be more specific, CPS uses several cavities composed of mirrors and beam splitters, making it difficult to inversely find desired phases of a pulse train that would result a stacked pulse with maximum peak intensity. Therefore, a reinforcement learning algorithm is required

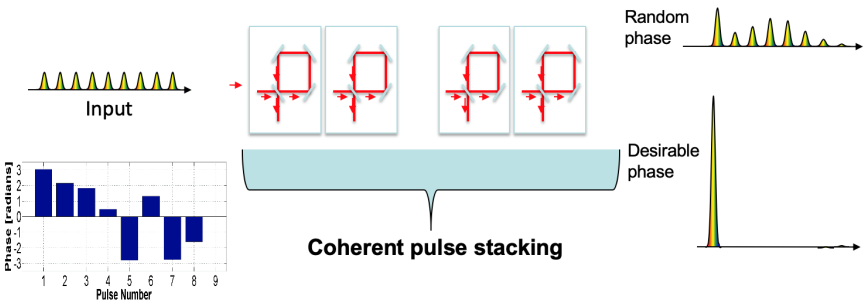

Figure 1: Principle of Coherent Pulse Stacking