Two-Stream Convolutional Networks for Dynamic Texture Synthesis

Matthew Tesfaldet
Department of Electrical Engineering and Computer Science
York University
Toronto, Canada
mtesfald@eecs.yorku.ca

Konstantinos G. Derpanis
Department of Computer Science
Ryerson University
Toronto, Canada
kosta@scs.ryerson.ca

Marcus A. Brubaker
Department of Electrical Engineering and Computer Science
York University
Toronto, Canada
mab@eecs.yorku.ca

Abstract

We introduce a two-stream model for dynamic texture synthesis. Our model is based on pre-trained convolutional networks (ConvNets) that target two independent tasks: (i) object recognition, and (ii) optical flow prediction. Given an input dynamic texture, statistics of filter responses from the object recognition ConvNet encapsulates the per frame appearance of the input texture, while statistics of filter responses from the optical flow ConvNet models its dynamics. To generate a novel texture, a noise input sequence is optimized to simultaneously match the feature statistics from each stream of the example texture. Inspired by recent work on image style transfer and enabled by the two-stream model, we also apply the synthesis approach to combine the texture appearance from one texture with the dynamics of another to generate entirely novel dynamic textures. We show that our approach generates novel, high quality samples that match both the framewise appearance and temporal evolution of an input example.

1 Introduction

Many common temporal visual patterns are naturally described by the ensemble of appearance and dynamics (*i.e.*, temporal pattern variation) of their constituent elements. Examples of such patterns include fire, fluttering vegetation, wavy water among others. Understanding and characterizing these temporal patterns has long been a problem of interest in human perception, computer vision, and computer graphics. These patterns have been studied under a variety of names, including turbulent-flow motion [18], temporal textures [28], time-varying textures [3], dynamic textures [7], textured motion [43] and spacetime textures [6]. Here, we adopt the term "dynamic texture". In this work, we propose a factored analysis of dynamic textures in terms of appearance and temporal dynamics.

31st Conference on Neural Information Processing Systems (NIPS 2017), Long Beach, CA, USA.