

# Seam Carving Through Time

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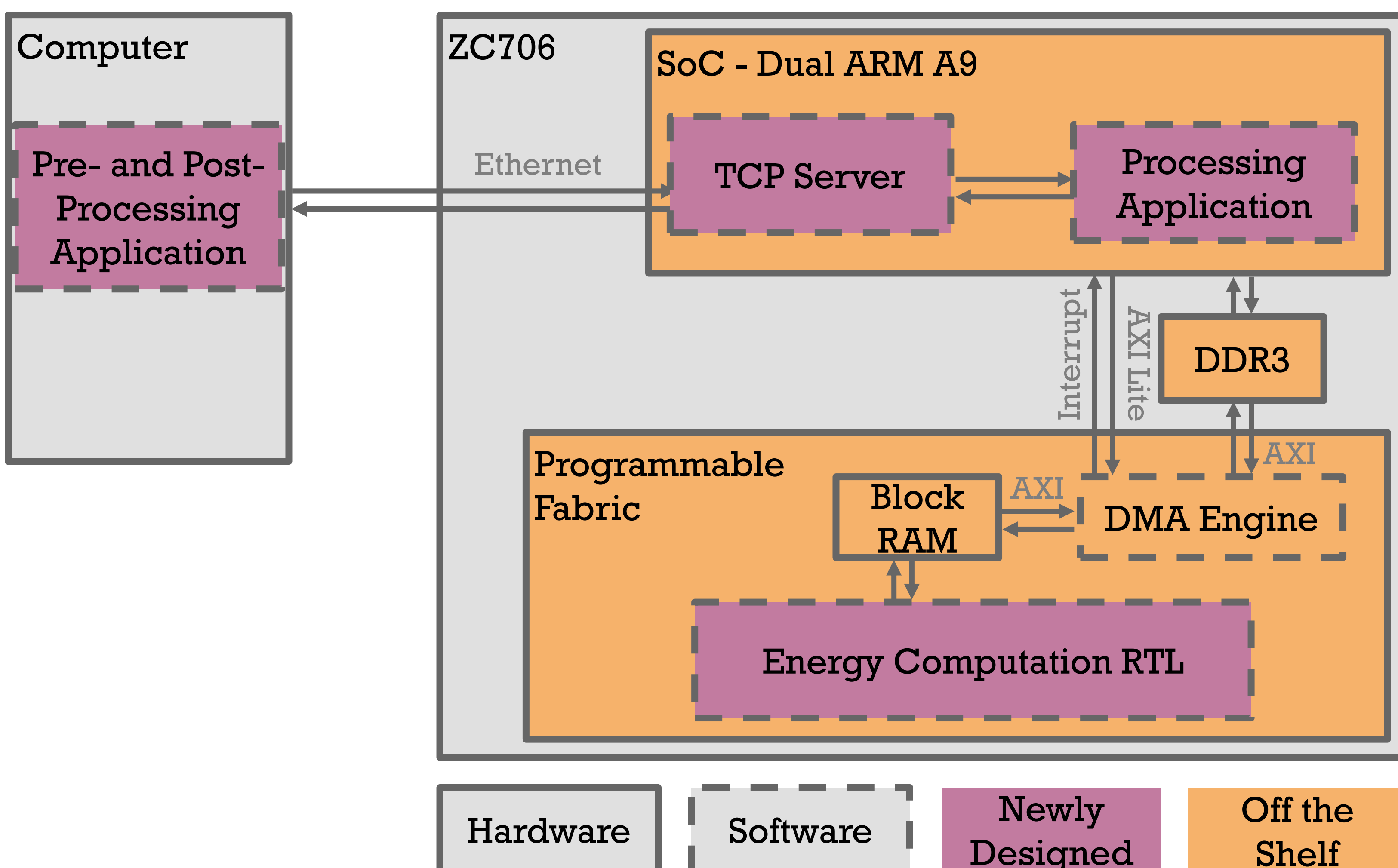
## Overview

The Seam Carving Through Time (SCTT) project aims to increase the playback speed of a video while preserving its salient features. We apply the seam carving algorithm, which was originally developed for content-aware image rescaling, against the time dimension of a video to shorten it to a target playback speed. The project presents a system pipeline aiming to accelerate the seam carving operation. The accelerating system comprises three main components: a software application on an external computer, a system on chip (SoC) performing seam minimization and removal, and the programmable fabric to perform high-speed energy mapping.

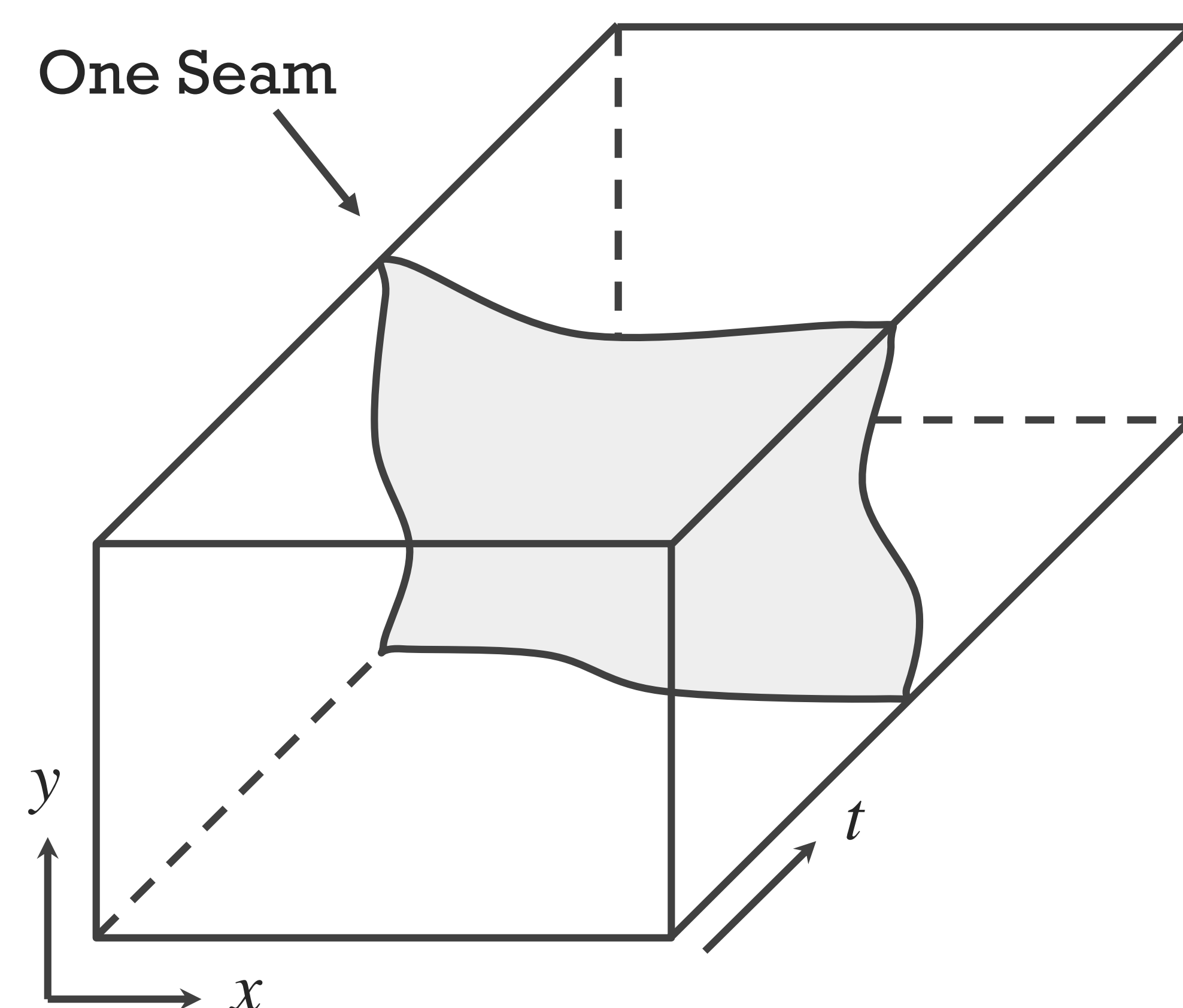
## Motivation

- (1) The most prevalent method for increasing video playback speed is by cutting out frames uniformly. This method ignores the content of the video entirely, resulting in parts of the video being altered to an unrecognizable speed. Content-aware rescaling of playback speed can create shorter videos while maintaining coherence.
- (2) Seam carving, an established algorithm for content-aware rescaling, is computationally-intensive and is slow on traditional system architectures. Accelerating the entire system by leveraging hardware capabilities is a natural interest for both the application and the algorithm itself.

## System Architecture



## Visualization



## Approach

1. Pre-process the video into an array of bytes
2. Send the byte stream to the SoC over Ethernet
3. SoC initiates DMA transfer of video data to BRAM
4. Programmable logic computes energy function
5. DMA transfer energies from BRAM to DRAM
6. SoC finds minimum seam using energies
7. SoC removes seam, updates pixels in DRAM

## Evaluation

We met our main goal of smoothly processing a video to increase its average playback rate by 1.5x. We have included several other high- and low-level goals and their corresponding metrics below:

Goal	Metric
Increase playback speed by 1.5x	Frame count
Video is smooth	Subjective appraisal, energy function
Process a video of duration $T$ in time $3T$	On-board timing
Send byte stream of seam carved video to PC	Bits / second

## Additional Information



[course.ece.cmu.edu/~ece500/projects/s19-teamd9/](http://course.ece.cmu.edu/~ece500/projects/s19-teamd9/)