CLIENT-SIDE GPGPU WEB APPLICATION FOR CATCHMENT DELINEATION AND WATERSHED SEGMENTATION

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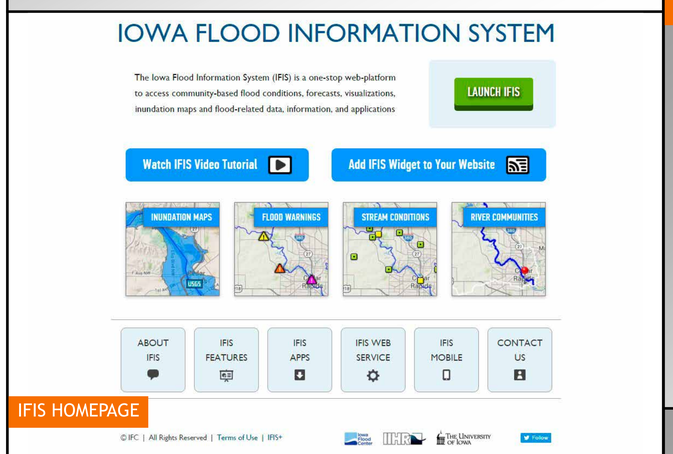
Project Summary: The advancements and new techniques in information technologies are making it possible to acquire enormous amount of spatial data from various gauges and other data sources. This collection of data increased demand for applications which are capable of managing and processing large-scale and high-resolution terrain data. A novel example of these applications is the Iowa Flood Information System, which is a web-based one stop platform for accessing community-based flood conditions, forecasts, visualizations, inundation map and flood related data, information and application. With these huge amount of data provided, one of the most challenging tasks for terrain analysis is the delineation of watersheds. Watershed delineation is a process for creating a boundary that represents the contributing area for a specific control point or water outlet, with intent of characterization and analysis of portions of a study area. Although traditional methods for watershed analysis are giving high accuracy results, it becomes more burdensome as the data resolution increases. In this project, we utilized client-side GPU's to analyze high-resolution watersheds by developing a new algorithm for watershed delineation which allows parallelization.

IFIS — Iowa Flood Information System

Provides access to flood inundation maps, real-time flood conditions, flood warnings and forecasts, flood-related data, information and interactive visualizations for communities in Iowa

Key elements of the IFIS are:

- Flood inundation maps,
- Rainfall products (5 min to daily/weekly, accumulations) in spatial and temporal high resolution,
- Autonomous "bridge sensors" monitoring real-time water level in streams,
- Real-time flood forecasting model providing flood forecast and warnings to over 1000 communities in Iowa



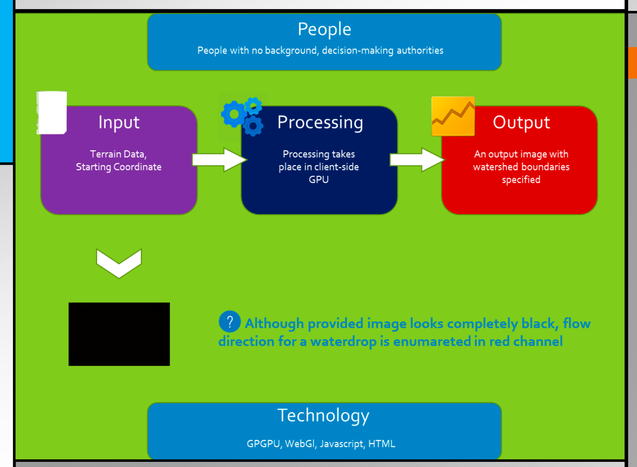
IFIS HOMEPAGE

PROJECT DESCRIPTION

- This poster provides an overview of a new method to delineate watersheds in a given terrain on a web-based cyberinfrastructure system, and its implementation to Iowa Flood Information System.

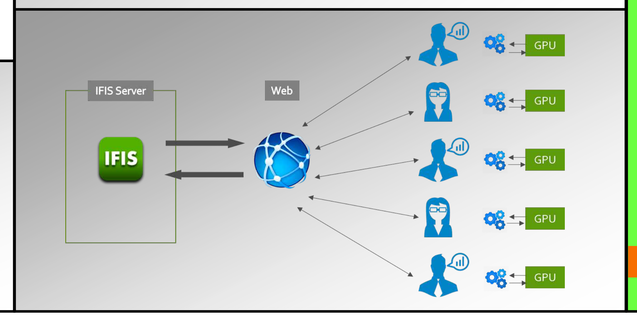
BACKGROUND

- An input image which consists of the flow direction for a water drop in a particular location, is provided to the algorithm.
- Each water drop can be headed to 8 different directions. Each direction is enumerated in red channel.



SIGNIFICANCE

- Due to the advancements and new techniques in information technologies, enormous amount of spatial data is available for terrain analysis.
- Although, traditional methods for watershed analysis are giving high accuracy results, it becomes more burdensome as the data resolution increases, and there is no client-side analysis tool for watershed delineation



METHODOLOGY

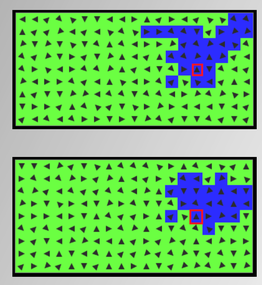
1) For every pixel in the input image, we retrieve the direction value encoded in the RGBA components.
2) We convert the direction value to the implied coordinate, with our WebGL-optimized formula.
3) If the encoded value of the calculated coordinate is a "watershed" instead of a direction value, we mark the current pixel as "watershed"

DEMONSTRATION

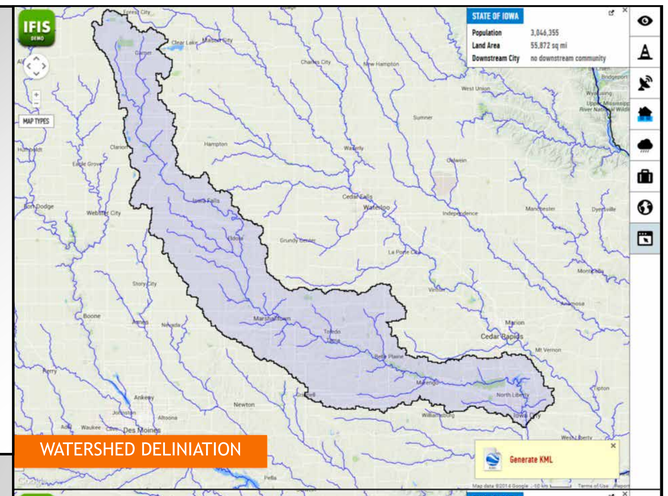
Progress of the algorithm is demonstrated using simple visualizations for better understanding.

Blue line represents the watershed discovered, and arrow directions represents the flow directions

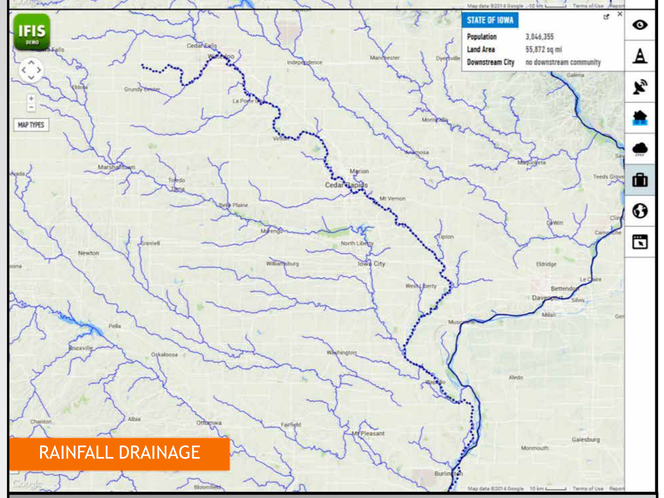
In this demonstration, all 8 directions are used as in real life application, and red square indicates the starting point.



USE CASE RESULT FOR IOWA



WATERSHED DELINIATION



RAINFALL DRAINAGE

OVERVIEW

This abstract provides an overview of a new method to delineate watersheds in a given terrain on a web-based cyberinfrastructure system, and its implementation to IFIS. Using the impressive power of GPU, we were able to reduce the average execution time of watershed delineation method significantly in comparison to any other server-or-client side architecture. Our goal for future work is to improve other hydrologic analysis methods such as raindrop flow tracking by adapting presented approach.

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