

UNIVERSITÄT DUISBURG-ESSEN

BACHELOR THESIS

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# Development and Comparison of Overview Techniques for Extreme Resolution Datasets

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*for*

The High Performance Computing Group  
Department Engineering

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*“To see a world in a grain of sand, hold infinity in the palm of your hand. ”*

William Blake

UNIVERSITÄT DUISBURG-ESSEN

# *Abstract*

Fakultät für Ingenieurwissenschaften

International Studies in Engineering (ISE) PO08

Computer Engineering

Bachelor of Science

## **Development and Comparison of Overview Techniques for Extreme Resolution Datasets**

by Danyun LEI

The Thesis Abstract is written here (and usually kept to just this page). The page is kept centered vertically so can expand into the blank space above the title too...

## *Acknowledgements*

I hereby express my deep sense of gratitude and indebtedness to Prof. Dr. Jens Krüger, for your valuable guidance, encouragement and support. Your patience and faith in me was a key reason that I could finish the work.

Also I express my thanks to Prof. Dr. Yunqi Lei, Dr. Bixia Wu and Dr. Franz-Josef Schmitz. Without your support, I could not have finished the task successfully.

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# List of Abbreviations

<b>HTML</b>	<b>H</b> ypertext <b>M</b> arkup <b>L</b> anguage
<b>JS</b>	<b>J</b> ava <b>S</b> cript
<b>CSS</b>	<b>C</b> ascading <b>S</b> tyle <b>S</b> heets
<b>DOM</b>	<b>D</b> ocument <b>O</b> bject <b>M</b> odel
<b>URL</b>	<b>U</b> niform <b>R</b> esource <b>L</b> ocator
<b>JSON</b>	<b>J</b> ava <b>S</b> cript <b>O</b> bject <b>N</b> otation
<b>UI</b>	<b>U</b> ser <b>I</b> nterface

# Physical Constants

Speed of Light  $c_0 = 2.997\,924\,58 \times 10^8 \text{ m s}^{-1}$  (exact)

# List of Symbols

$a$	distance	m
$P$	power	W (J s <sup>-1</sup> )
$\omega$	angular frequency	rad

*Special thanks to Dr. Zhonghua Xu, Ms. Meng Wang and Mrs.  
Vivian Elizabeth Rice, I wish I could share the joy of this  
achievements with all of you - here or in Azeroth.*

## Chapter 1

# Introduction and Objectives

### 1.1 Main Section 1

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#### 1.1.2 Subsection 2

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### 1.2 Main Section 2

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## Chapter 2

# Background

### 2.1 Main Section 1

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#### 2.1.1 Subsection 1

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## Chapter 3

# Requirements and Concepts

### 3.1 Main Section 1

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#### 3.1.1 Subsection 1

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#### 3.1.2 Subsection 2

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### 3.2 Main Section 2

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## Chapter 4

# Implementation

In this chapter, the overall structure of the project, how the files are arranged and the functionalities of each components, will be described in details.

### 4.1 Files And Folders

The folder names and file names are mostly self-explanatory or conventional in this project. They'll be described briefly in this section.

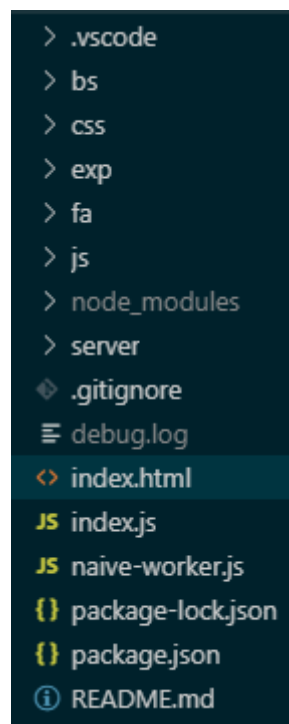


FIGURE 4.1: A glimpse of files and folders.

#### 4.1.1 Folders

**Folder** `./vscode`

**Folder** ./js

**Folder** ./css

**Folder** ./fa

**Folder** ./bs

**Folder** ./node\_modules

**Folder** ./exp

### 4.1.2 Top Level Files

**File** index.html

**File** index.js

**File** naive-worker.js

**File** package.json

**File** package-lock.json

**File** README.md

**File** .gitignore

## 4.2 Front End

Since this project is a pure web project, the front end occupies a large portion of the codes.

### 4.2.1 HTML Entry index.html

The entry of the project is where this program gets started, in similar concept of the `main()` function in C or the public static `void main(String[] args)` function in Java. The entry point is a **HTML** file and as expected named `index.html`. It introduces the front end structure of the project in raw.

First part of the **HTML** file is the `<head>` part. In this part, the character set of this web page is defined as *UTF-8*, the size of the entire **HTML** document as fullscreen size, scaling not allowed and not shrinking to display its content.

```
<meta charset="utf-8">
<meta name="viewport" content="width=device-width,
    initial-scale=1, shrink-to-fit=no">
```

And then all the needed **CSS** files are included to end the `<head>` part. Besides the **CSS** files which will be described in 4.2.3, the necessary **CSS** files from third-party open source vendors are also included, including *Bootstrap's CSS* part, *FontAwesome* and *MiniBar CSS* assets.

The `<body>` part is the essential part of the **HTML** entry, which describes the structure of what users can “actually see”. It begins first with three `<div>` tags for the most important three parts of this project, the container for main background canvases, the container for mini-maps, and the container for the control panel floating on the top right corner of the **UI** screen. The positioning, sizes and container behaviours of these `<div>`s are defined in the **CSS** files which are already included. Before users set any effects up, these properties mostly come from the file `./css/common.css`.

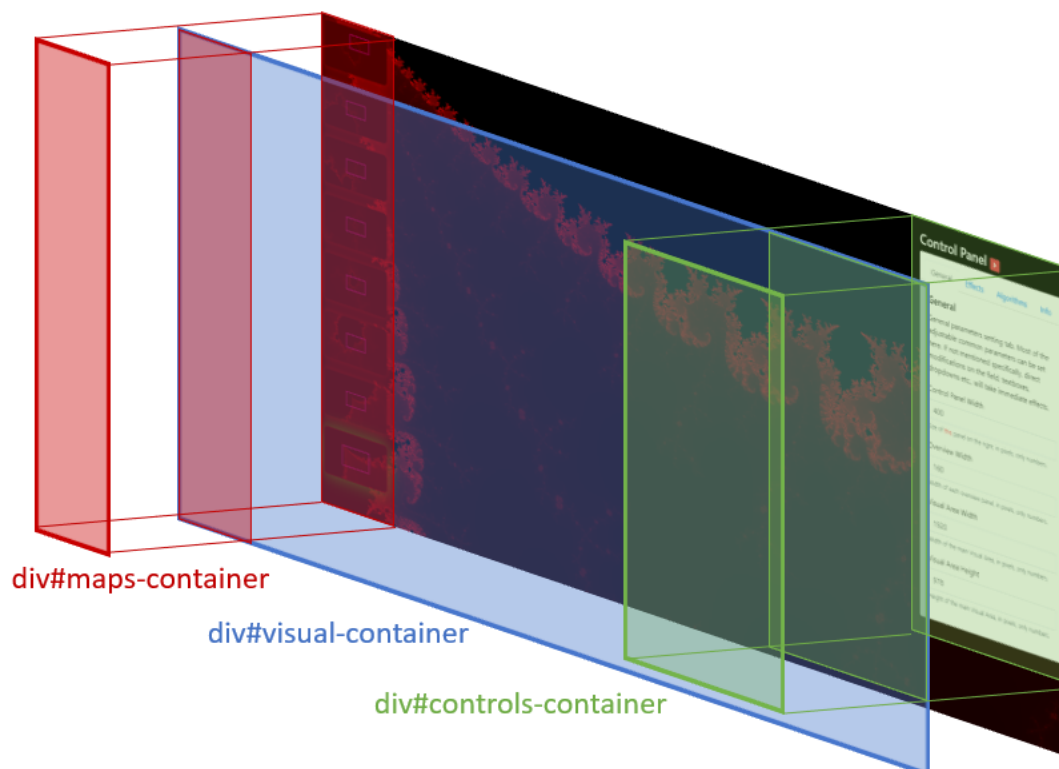


FIGURE 4.2: **DOM** structure in `<body>` tag.

After the visual `<div>` part, several `<script>` tags come after it to include what's necessary for the essential coding part. Here firstly are the dependencies of the project, including *jQuery*, *Bootstrap's JS* part, and *MiniBar's JS* part. And then at the very end the main *JS* file `index.js` is included and all the core programs of this project goes in there.

Worth noting that conventionally all *JS* files should be included at the very end of the page as what we are doing now, unless the *JS* file is needed before the render phase of the web page. This way if the *JS* file is a little bit bigger than usual, the loading of the *JS* files won't affect the rendering process of the *DOM* documents.

## 4.2.2 Main JavaScript `index.js`

The main *JS* file `index.js` is where we put our core code, where we

## 4.2.3 CSSs For Overview Effects

Folder `./css` includes five *CSS* files, each setting up some visual effects of the project.

File `./css/common.css` first sets up all general appearance of the elements on the web page when no parameters or effects are set. File `./css/dock.css` sets up the appearance when *Scrollbar + Dock* is activated, only the iOS Dock part and file `./css/minibar.css` sets up the scroll bar part. File `./css/stacked.css` sets up the effects of stacked cards. File `./css/tabs.css` sets up the effects of the tab selection on the top.

## 4.3 Back End Calculation

The back end calculation is done in the *JS* file `naive-worker.js`. This file is being used for initializing the *WebWorkers* inside `index.js` dynamically. Whenever a calculation or extraction for a specific region of a dataset is needed, the main *JS* file `index.js` is going to send a message to `naive-worker.js` with desired parameters and this back end will respond with corresponding image data.

### 4.3.1 Global Scope

In the global scope of this file, the following things were done.

**Includes** The `decimal.js` dependency is included for high-precision floating points calculation. Default parameters for the dependency is set.

**Constants** Constants of default screen width and default screen height are defined in case the front end doesn't give these parameters.

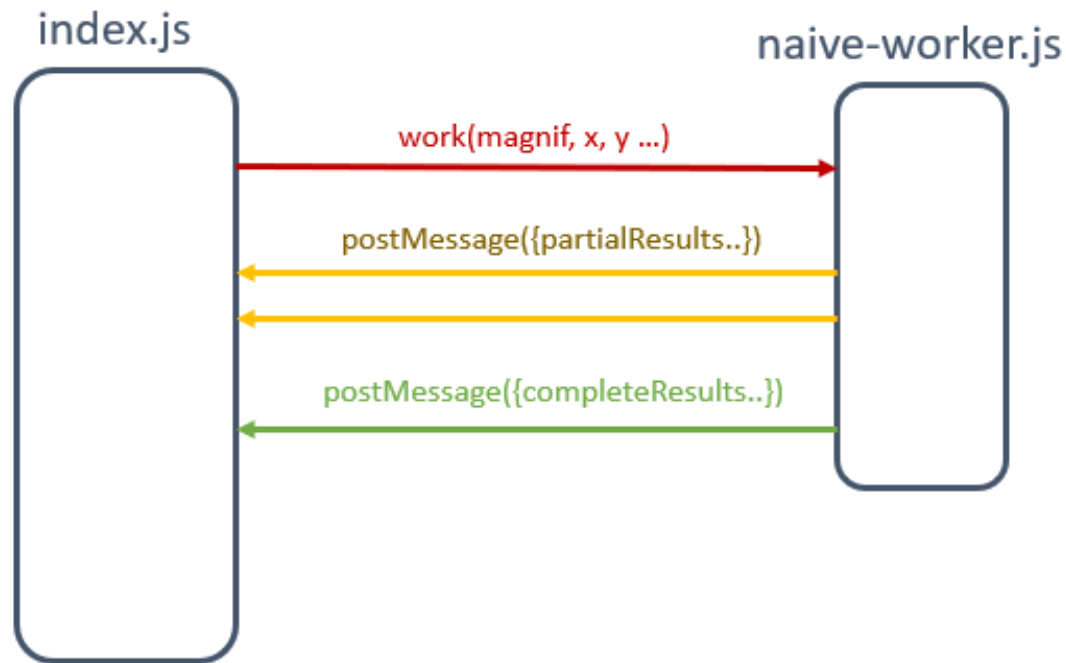


FIGURE 4.3: Message exchange between `index.js` and `naive-worker.js`.

**Canvas** An `OffscreenCanvas` instance is created and instantiated with the dimensions of by default the values of the defined constants. The `OffscreenCanvas` will be used as the canvas to generate the desired image on, and since it's not being shown on the screen, will occupy less system resources and boost the calculation speed. Corresponding variables is declared after the instantiation, respectively `canvas` for the `OffscreenCanvas` itself and `ctx` as the 2d context of the canvas.

### 4.3.2 Message Reception

### 4.3.3 Iteration Limit

### 4.3.4 Iteration Count for One Point

### 4.3.5 Image Generation

### 4.3.6 High Precision Version

## 4.4 Utility Assets

Other open source third-party utilities lie in different folders with corresponding names.



#### 4.4.1 Folder ./js

In ./js folder, all JS third-party files are here, including:

- File decimal.min.js is for high-precision floating points calculation for JavaScript.
- File jquery-3.4.1.min.js is for DOM traversal and manipulation, event handling and animation.
- File bootstrap.bundle.min.js is for some basic styling of the control panel sitting on top right corner of the screen.

#### 4.4.2 Folder ./fa

#### 4.4.3 Folder ./bs

#### 4.4.4 Folder ./css

## Chapter 5

# Discussion

### 5.1 Main Section 1

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#### 5.1.1 Subsection 1

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#### 5.1.2 Subsection 2

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### 5.2 Main Section 2

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## Appendix A

# Frequently Asked Questions

### A.1 How do I change the colors of links?

The color of links can be changed to your liking using:

```
\hypersetup{urlcolor=red}, or
```

```
\hypersetup{citecolor=green}, or
```

```
\hypersetup{allcolor=blue}.
```

If you want to completely hide the links, you can use:

```
\hypersetup{allcolors=.}, or even better:
```

```
\hypersetup{hidelinks}.
```

If you want to have obvious links in the PDF but not the printed text, use:

```
\hypersetup{colorlinks=false}.
```