

Steel Composition Classification Project

1. Project Overview

Objective:

Classify steel compositions using microstructural images and automate the recognition of phases (e.g., pearlite, ferrite, and martensite).

Focus:

Analyze the Fe-C-X system with a particular emphasis on hypoeutectoid alloys.

2. Dataset Details

Source:

Reflected light microscopy images of steel samples.

Scale:

Each image has a resolution of **400 μm** .

Labels:

Composition labels like `Fe_C_0.07_Mn_2.2` and `Fe_C_0.13_Ni_4_Cr_2_Mn_0.49_S_0.015`.

3. Planned Workflow

Step 1: Label microstructures in **Roboflow** using composition details.

Step 2: Use **clustering algorithms** to identify distinct microstructural phases (pearlite, ferrite, martensite, etc.).

- **Addition:** Use **Canny edge detection** to highlight the acicular structure of martensite for more accurate identification.

Step 3: Train two models:

- **Model 1:** Classifies **compositions** based on images.
- **Model 2:** Identifies and segments **microstructural phases**, including martensite.

Step 4: Integrate models for end-to-end classification.

4. Challenges

- Automating the identification of phases (e.g., pearlite, ferrite, and martensite) without manually labeling individual regions.
- Incorporating edge detection techniques like **Canny** to improve phase recognition for martensite, especially in steels with high carbon content.
- Handling complex microstructures in alloys with multiple elements.

5. Questions for the Professor

- Are there better approaches for automating the identification of pearlite, ferrite, and martensite phases in microstructures?
- Is **Canny edge detection** suitable for identifying martensite's acicular structure, or are there other advanced methods you'd recommend?
- How can I ensure accurate phase recognition in alloys with varying chemical compositions?
- Would integrating energy-dispersive X-ray spectroscopy (EDS) data improve classification accuracy?

6. References and Tools

Tools: Roboflow, clustering techniques, computer vision models, and Canny edge detection for martensite recognition.

References: Prior research on Fe-C-X microstructures, martensitic transformations, and steel phase recognition methods.