Call for Participation: QCRE Data Challenge Competition
2025 IISE Annual Conference & Expo
May 31 – June 3, 2025, Atlanta, GA

On behalf of the Quality Control & Reliability Engineering (QCRE) community, we would like to invite you to participate in the 2025 QCRE Data Challenge Competition at the IISE Annual Conference. This year's QCRE Data Challenge problem is sponsored by Zauron Labs. The dataset is provided by The University of Texas Medical Branch at Galveston.

In this data challenge, a research problem of Vertebral Fracture Detection is posed to participants. More details regarding the competition problem statement can be found in the attachment.

The organizing committee will hold a Q&A session through an online Teams meeting from **11AM to 12PM CST on February 21st, 2025**. The Q&A session will be recorded and posted on https://www.iise.org/Details.aspx?id=52424

Meeting link: link.iise.org/QCREData2025**, 11AM to 12PM CST on February 21st, 2025.**

Eligibility

- Individuals or teams of a maximum of four members.

- At least one of the team members must be an active member of the Institute of Industrial & Systems Engineers (IISE) and Quality Control & Reliability Engineering (QCRE) division.

- Each team can only participate once.

- Each team should submit a Notice of Intent Form to enter the competition (check details in the **Notice of Intent** section).

- Completing Steps 1-3 in the **Submission** section is required for any team to be eligible as a finalist.

- Participating teams are required to publicly release their solutions, including source code and trained model weights, on open-source platforms under the MIT license.

- Finalist teams acknowledge that the competition organizers will publish their technical papers, solutions, source code, and trained model weights on the official competition GitHub page https://github.com/SHAFNehal/IISE_QCRE_Data_Challange_2025.

- Participants must not share the challenge data publicly. Instead, they should refer to the original data request link provided by the competition organizers for access and distribution guidelines.

Notice of Intent

Each team must submit a Notice of Intent Form by **March 7th, 2025**, through https://forms.office.com/r/ics3Lx9y6V to express their interest in entering the competition. The data will start to be released to each team on a First Come First Serve. The form requires the following information: Team members, Institution, Main point of contact (name and email address), and Copyright release agreement.

Submission Guidelines

Step 1: Initial Submission

Participating teams or individuals must submit the following files to iiseqcredcc@gmail.com and copy all the Chairs of the Competition Steering Committee no later than **April 14, 2025**:

1. The source code for model development and training.
2. The source code for model prediction (**"predictions.py"**).
3. The trained model weights.

File Structure

The submitted files should follow the structure below:

|- DataFile

   |- train_data

   |- test_data

  |- trained_weights

  |- train.py

  |- predictions.py

The primary script for generating predictions must be named **"predictions.py"**. This script should be capable of directly loading the trained model weights, reading DICOM files from the *test_data* folder or any other designated held-out test dataset, and producing the corresponding predictions.

It is imperative that the prediction script **"predictions.py"** runs without requiring any modifications. Any necessary software dependencies should be explicitly stated in the submission. Additionally, a **ReadMe file** must be included, providing clear instructions on how to execute the code.

Step 2: Technical Report Submission

All **finalists** will be required to submit a **technical report** (not exceeding five pages, excluding references) by **May 15, 2025**. The report should include the following sections:

- **Team Members**: Names, affiliations, and roles.
- **Introduction**: Overview of the problem and motivation.
- **Methodology**: Description of the approach, models, and techniques used.
- **Data Analysis/Result Discussion**: Insights derived from the data and model performance.
- **Conclusions**: Summary of findings and implications.

Additionally, the submission email must include:

- A **list of team members**, including their full **affiliations** and **contact information** (email and phone number).
- Identification of **one team member** as the **primary contact** for the team.

Email your submission Data Competition steering committee.

Step 3: Finalist Presentation at the IISE Annual Meeting

Finalist teams must showcase their work at the **2025 IISE Annual Conference & Expo**. At least **one team member** from each finalist team is required to register for the conference and present their technical details during the **QCRE Data Challenge Competition showcase session**.

For any further inquiries, please contact the Chair of the Competition Steering Committee.

Evaluation and Selection of Winner

The **Competition Steering Committee** will assess submissions based on the files specified in **Step 1** of the **Submission** section. **Only teams that have submitted all the required files** in Step 1 will be considered for evaluation. The evaluation committee will include at least one representative from the **data sponsor partner** with domain expertise.

The model performance will be measured based on

$$\textbf{Score} = \text{Mean Average Precision (mAP)@0.5}$$

mAP@0.5 indicates mean average precision at IoU threshold of 50% for the object detection tasks.

Selection Process
- A **maximum of four teams** with the highest **Score** will be selected as **candidate finalists**.
- Finalists will be invited to proceed with **Steps 2 and 3** outlined in the **Submission** section.
- Among the finalist teams, those who successfully complete **all three steps** will be ranked based on their **Score**, and the top four teams will be awarded **1st to 4th place prizes** accordingly.

For any further questions, participants may reach out to the **Competition Steering Committee**.

Award

A maximum of the top four teams will be selected as finalists and will receive both a certificate and a monetary award based on their ranking. All the eligible finalists will also be recognized in the QCRE town hall meeting. If a team is unable to meet any item in the Eligibility section, the team may be excluded from the finalist selection. In this case, fewer than four teams may be awarded.

- The 1st prize comprises a certificate and a cash prize of $1,000.
- The 2nd prize comprises a certificate and a cash prize of $500.
- The 3rd prize comprises a certificate and a cash prize of $200.
- The 4th prize comprises a certificate and a cash prize of $100.

Important dates/deadlines
- Notice of Intent: **March 7th, 2025**
- Data will be released upon receiving the Notice of Intent and no later than **March 14th**.
- Deadline for submission of the results: **April 14th, 2025**
- Notification to the finalist teams: **April 21st, 2025**
- IISE Annual Conference & Expo, **May 31 – June 3, 2025**

Competition Chairs

Syed Hasib Akhter Faruqui, Ph.D.
Assistant Professor
Department of Engineering Technology
Sam Houston State University
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Qing Li, Ph.D. in Statistics
Assistant Professor
Department of Industrial and Manufacturing Systems Engineering
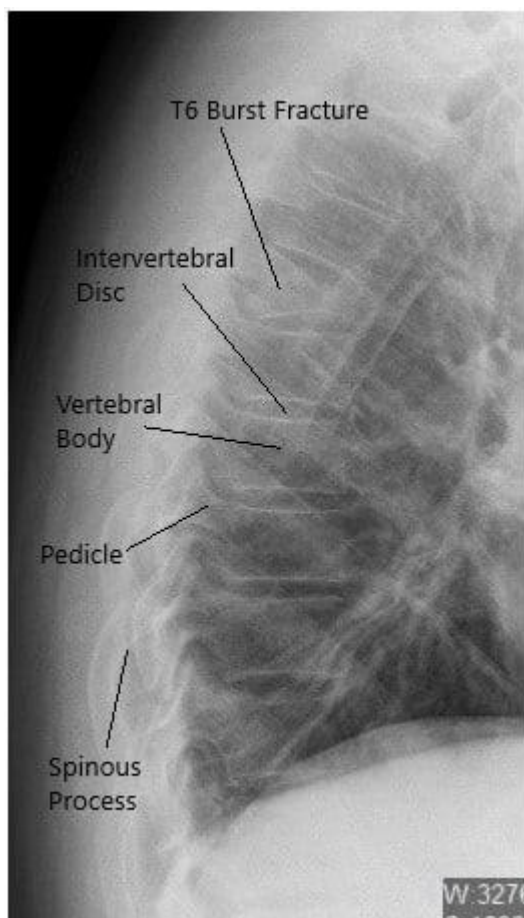Iowa State University
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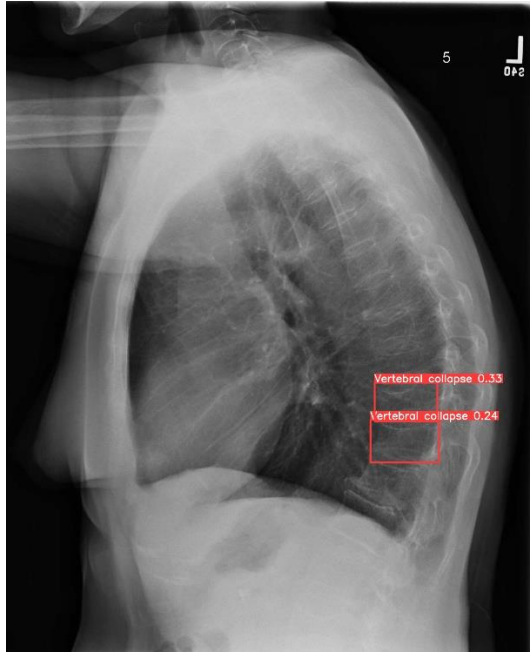Mississippi State University
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Problem Introduction

Vertebral fractures are among the most common spinal injuries, often resulting from osteoporosis or high-energy trauma. These fractures primarily affect the thoracolumbar spine and can lead to significant pain, mobility issues, and an increased economic burden. Accurate and timely diagnosis is essential for guiding appropriate treatment and improving patient outcomes.

Currently, detecting vertebral fractures from X-ray scans require manual interpretation by radiologists, which can be time-consuming and prone to human error. Given the high volume of imaging studies, radiologists often face challenges in efficiently identifying fractures, especially in emergency settings where rapid decision-making is critical.

Source: https://www.cortho.org/case-studies/spine/management-of-58-year-old-female-with-burst-fracture-of-t6-vertebra/

Challenges in Fracture Detection

1. **Variability in Fracture Presentation:**

   - Fractures can be subtle and may not always be easily distinguishable from normal anatomical variations or degenerative changes.

   - Differences in fracture severity and morphology require careful assessment.

2. **Time Constraints:** Radiologists must review large volumes of medical images, increasing the risk of delayed diagnosis and treatment.

3. **Error Risks:** Fatigue, differences in radiologist experience levels, and the complexity of image interpretation contribute to diagnostic errors.

4. **Data Challenges:**

   - Variability in scan quality, patient demographics, and scanner parameters can affect detection performance.

   - Class imbalance between fractured and non-fractured cases can introduce biases in model training.

5. **Clinical Relevance:** Any automated solution must generalize well across different datasets and maintain clinical applicability by ensuring high sensitivity and specificity.

Problem Statement

Participants are tasked with developing a machine learning model capable of accurately detecting the presence or absence of acute vertebral body fractures in thoracic spine X-rays.

The main task is to generate the Spinal Vertebral Fracture Localization Bounding Box.

Participants should focus on achieving:

- **High sensitivity and specificity** to minimize false negatives and false positives.
- **Robust generalization** across diverse patient data and imaging conditions.

Data: UTMB 1000 Thoracic Spine X-Rays

The dataset consists of labeled X-ray scans, annotated by expert radiologists, and is divided into:

1. **Training Set:**

   - Includes X-ray scans with labelled vertebral fractures and normal cases.
   - Fractures are labelled using criteria of >= 20% height loss between the anterior (front), middle, or posterior (back) of the vertebral body. Typically, the >=20% loss in height affects the anterior/front of the vertebral body and the posterior part is used as a reference point.

2. **Validation Set:**

   - Used for model tuning and performance assessment.

3. **Test Set:**

   - Held out for final evaluation.

4. **Format:**

   - X-ray scans are provided in DICOM format.

   - Preprocessing includes voxel normalization and resolution standardization.

   - A data loading script and preprocessing guidelines will be provided.

5. **Exclusion Criteria:**

   - Patients with known spinal surgery evidenced by spinal fixation hardware.

Evaluation Metrics

Model performance will be evaluated based on:

Mean Average Precision (mAP): This is commonly used to analyse the performance of image segmentation. This challenge aims to advance automated fracture detection methods, reducing radiologist workload and improving patient care through faster, more reliable diagnoses.

Useful Resources

Pydicom, Python package for reading DICOM data. https://github.com/pydicom/pydicom

Github Page for 2025 IISE QCRE Data Challenge.

https://github.com/SHAFNehal/IISE_QCRE_Data_Challange_2025