

# Multi-Contrast Computed Tomography Atlas of Healthy Pancreas

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**Abstract.** With the substantial diversity in population demographics, such as differences in age and body composition, the volumetric morphology of pancreas varies greatly, resulting in distinctive variations in shape and appearance. Such variations increase the difficulty at generalizing population-wide pancreas features. A volumetric spatial reference is needed to adapt the morphological variability for organ-specific analysis. Here, we proposed a high-resolution computed tomography (CT) atlas framework specifically optimized for the pancreas organ across multi-contrast CT. We introduce a deep learning-based pre-processing technique to extract the abdominal region of interests (ROIs) and leverage a hierarchical registration pipeline to align the pancreas anatomy across populations. Briefly, DEEDs affine and non-rigid registration are performed to transfer patient abdominal volumes to a fixed high-resolution atlas template. To generate and evaluate the pancreas atlas template, multi-contrast modality CT scans of 443 subjects (without reported history of pancreatic disease, age: 15-50 years old) are processed. Comparing with different registration state-of-the-art tools, the combination of DEEDs affine and non-rigid registration achieves the best performance for the pancreas label transfer across all contrast phases (non-contrast: 0.497, arterial: 0.505, portal venous: 0.494, delayed: 0.497). We further perform external evaluation with another research cohort of 100 de-identified portal venous scans with 13 organs labeled, having the best label transfer performance of 0.504 Dice score in unsupervised setting. The qualitative representation (e.g., average mapping) of each phase creates a clear boundary of pancreas and its distinctive contrast appearance. The deformation surface renderings across scales (e.g., small to large volume) further illustrate the generalizability of the proposed atlas template.

**Keywords:** Computed Tomography · Registration · Pancreas.

## 1 Introduction

With the complicated relationship between physiological and metabolic process in the human body, substantial efforts are underway to map the organization and molecular

\* Contributed equally to this work.

# Atlas Of Computed Tomography Variants

**Huangqi Zhang**



## **Atlas Of Computed Tomography Variants:**

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## **Table of Contents Atlas Of Computed Tomography Variants**

1. Understanding the eBook Atlas Of Computed Tomography Variants
  - The Rise of Digital Reading Atlas Of Computed Tomography Variants
  - Advantages of eBooks Over Traditional Books
2. Identifying Atlas Of Computed Tomography Variants
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Atlas Of Computed Tomography Variants
  - User-Friendly Interface
4. Exploring eBook Recommendations from Atlas Of Computed Tomography Variants
  - Personalized Recommendations
  - Atlas Of Computed Tomography Variants User Reviews and Ratings
  - Atlas Of Computed Tomography Variants and Bestseller Lists
5. Accessing Atlas Of Computed Tomography Variants Free and Paid eBooks
  - Atlas Of Computed Tomography Variants Public Domain eBooks
  - Atlas Of Computed Tomography Variants eBook Subscription Services
  - Atlas Of Computed Tomography Variants Budget-Friendly Options
6. Navigating Atlas Of Computed Tomography Variants eBook Formats
  - ePub, PDF, MOBI, and More
  - Atlas Of Computed Tomography Variants Compatibility with Devices
  - Atlas Of Computed Tomography Variants Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Atlas Of Computed Tomography Variants
  - Highlighting and Note-Taking Atlas Of Computed Tomography Variants
  - Interactive Elements Atlas Of Computed Tomography Variants
8. Staying Engaged with Atlas Of Computed Tomography Variants

- Joining Online Reading Communities
- Participating in Virtual Book Clubs
- Following Authors and Publishers Atlas Of Computed Tomography Variants
- 9. Balancing eBooks and Physical Books Atlas Of Computed Tomography Variants
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Atlas Of Computed Tomography Variants
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Atlas Of Computed Tomography Variants
  - Setting Reading Goals Atlas Of Computed Tomography Variants
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Atlas Of Computed Tomography Variants
  - Fact-Checking eBook Content of Atlas Of Computed Tomography Variants
  - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
- 14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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depending on what happens to us sometimes we feel sad like

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dr radha is joined by her two puppet friends ben and breagha to find out about feeling sad and together they explore ways to help you feel happier this clip is from the series feeling

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introduce this synonym for sad word list to your class to help improve their vocabulary and sentence writing in their first years of primary school utilising these synonyms will make their creative writing pieces more expressive and efficient instead of using the word sad repetitively

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he feels angry happy calm sad and scared all at once to help him a little girl shows him what each feeling means through colour a gentle exploration of feelings for young 3 and old alike environmental learning for classroom and assembly at ks1 ks2 mal leicester 2009 03 06 in environmental learning for classroom and assembly at ks1

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activity sheet sad sam s choices and discuss the options they have chosen further suggestions ask the children to make happy and sad puppets and then make up their own story using happy and sad puppet characters ask the children to make happy and sad mobiles or jigsaws ask the children to find happy and sad images in

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