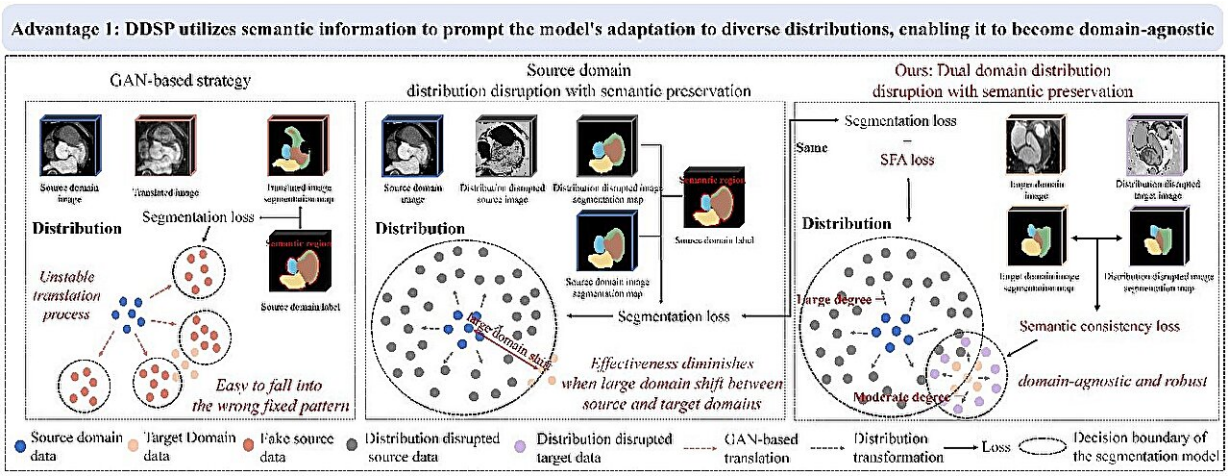
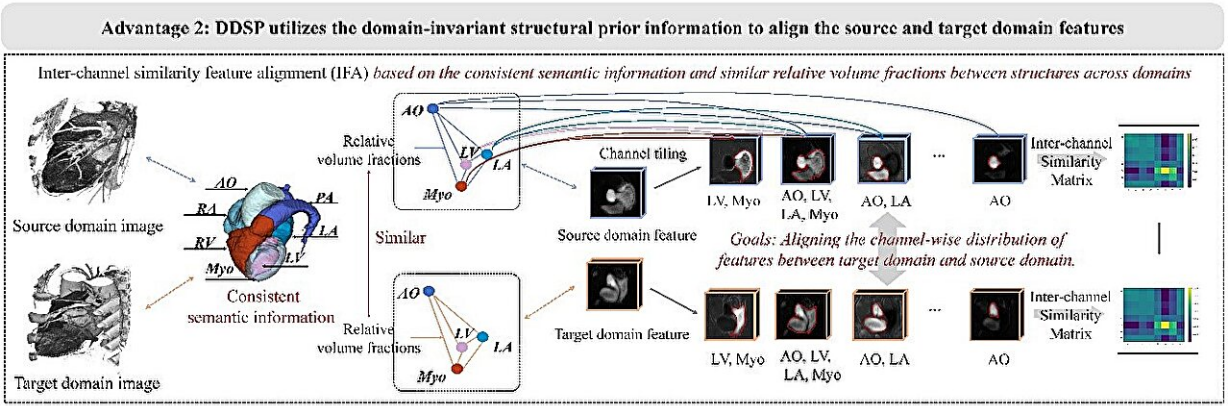
New unsupervised domain adaptation framework enhances precision in medical image segmentation

August 13 2024



(a) Our solution to address the challenges in GAN-based UDA methods



(b) Our IFA improves the alignment between features from the source and target domains

The advantages of the DDSP framework: (a) Our strategy is to make the model domain-agnostic by exposing it to numerous diverse distributions while preserving semantic information in both source and target domains, rather than explicitly teaching it to generate images with target domain distributions via

GANs. (b) Our IFA utilizes the domain-invariant structural prior information to align the source and target domain features. Credit: Prof. Qin Wenjian

Recently, a research team developed an unsupervised domain adaptation (UDA) approach, the dual domain distribution disruption with semantics preservation (DDSP) framework, achieving high-precision cross-modality segmentation without dependency on target modality labels. The team was led by Prof. Qin Wenjian from the Shenzhen Institute of Advanced Technology (SIAT) of the Chinese Academy of Sciences (CAS).

The findings were published in *Medical Image Analysis*.

Medical imaging stands as a cornerstone of modern diagnostics. However, variability in imaging modalities and the scarcity of target labels pose significant challenges to precise segmentation.

To solve this problem, the researchers proposed the DDSP framework, a paradigm shift in UDA, offering a novel solution that diverges from the complexities of generative adversarial networks (GANs). This approach champions a model inherently adaptive and agnostic to domain variations, thereby simplifying the process and enhancing reliability.

"DDSP embodies the essence of simplicity and efficiency," said Prof. Qin. "It transcends the intricacies of GAN-based methods by leveraging a distribution disruption module to increase the diversity of image distributions around the source domains, while being constrained by semantic information to facilitate adaptation to distinct distributions."

Furthermore, the researchers enhanced the framework by incorporating an inter-channel similarity feature alignment. They skillfully utilized the

consistent semantic information and anatomical uniformity present across diverse imaging modalities, thereby boosting the framework's flexibility and precision in recognizing features.

Finally, the researchers validated the proposed method on three public medical imaging datasets, with results showing that DDSP outperformed current UDA techniques. Importantly, its efficacy is comparable to that of fully-supervised models, indicating its potential to facilitate high-quality medical image analysis without extensive target labeling requirements.

The proposed method has great potential to address the challenges of domain adaptation in medical image segmentation tasks, providing a promising avenue for future research in the field.

More information: Boyun Zheng et al, Dual domain distribution disruption with semantics preservation: Unsupervised domain adaptation for medical image segmentation, *Medical Image Analysis* (2024). DOI: 10.1016/j.media.2024.103275

Provided by Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences