An Inspiring Title for the MELBA Journal Sample Article

Adrian V. Dalca adalca@mit.edu

EECS, Massachusetts Institute of Technology, Cambridge, MA, USA

Mert R. Sabuncu msabuncu@cornell.edu

School of Electrical and Computer Engineering, Cornell University, Ithaca, NY, USA

Abstract

We develop a learning framework for building deformable templates, which play a funda-1 2 mental role in many image analysis and computational anatomy tasks. Conventional methods for template creation and image alignment to the template have undergone decades of 3 rich technical development. In these frameworks, templates are constructed using an iterative process of template estimation and alignment, which is often computationally very 5 expensive. Due in part to this shortcoming, most methods compute a single template for 6 the entire population of images, or a few templates for specific sub-groups of the data. In this work, we present a probabilistic model and efficient learning strategy that yields either universal or conditional templates, jointly with a neural network that provides efficient alignment of the images to these templates. We demonstrate the usefulness of this 10 method on a variety of domains, with a special focus on neuroimaging. This is particularly 11 useful for clinical applications where a pre-existing template does not exist, or creating a 12 new one with traditional methods can be prohibitively expensive. Our code is available 13 at http://yoururl.com. 14

Keywords: Machine Learning, Image Registration

1. Introduction

15

A deformable template is an image that can be geometrically deformed to match images in a dataset, providing a common reference frame. Templates are a powerful tool that enables the analysis of geometric variability. They have been used in computer vision, medical image analysis, graphics, and time series signals.

2. Related Works

Spatial alignment, or registration, between two images is a building block for estimation of
 deformable templates. Alignment usually involves two steps: a global affine transformation,
 and a deformable transformation (as in many optical flow applications).

Use \cite{} for reference that is part of the sentence, and \citep{} for references in parenthesis. For example, Viola and Wells III (1997) is awesome. Also, this is a citation (Viola and Wells III, 1997).

© 2020 Dalca and Sabuncu. License: CC-BY 4.0. Guest Editors: Marleen de Bruijne, Tal Arbel, Ismail Ben Ayed, Hervé Lombaert https://www.melba-journal.org/article/XX-AA.

28 3. Methods

29 3.1 Equations

We estimate the deformable template parameters θ_t and the deformation fields for every data point using maximum likelihood. Letting $\mathcal{V} = \{v_i\}$ and $\mathcal{A} = \{a_i\}$,

$$\hat{\theta}_{t}, \hat{\mathcal{V}} = \arg \max_{\theta_{t}, \mathcal{V}} \log p_{\theta_{t}}(\mathcal{V}|\mathcal{X}, \mathcal{A})
= \arg \max_{\theta_{t}, \mathcal{V}} \log p_{\theta_{t}}(\mathcal{X}|\mathcal{V}; \mathcal{A}) + \log p(\mathcal{V}),$$
(1)

- where the first term captures the likelihood of the data and deformations, and the second
- 31 term controls a prior over the deformation fields.
- 32 **Proof** Awesome proof.

33

34 Acknowledgments

- This work was supported by grants X, Y and Z. We also acknowledge important conversa-
- 36 tions with our colleagues A, B and C.

37 Ethical Standards

- 38 The work follows appropriate ethical standards in conducting research and writing the
- manuscript, following all applicable laws and regulations regarding treatment of animals or
- 40 human subjects.

41 Conflicts of Interest

The conflicts of interest have not been entered yet.

43 Appendix A.

- 44 In this appendix we prove the central theorem and present additional experimental results.
- 45 Remainder omitted in this sample.

46 References

- 47 Paul Viola and William M Wells III. Alignment by maximization of mutual information.
- International journal of computer vision, 24(2):137–154, 1997.