Domains shift, which occurs when there is a mismatch between the distributions of training (source) and testing (target) datasets, usually results in poor performance of the trained model on the target domain. A domain adaptation problem involves two domains: the source domain and the target domain. The source domain is composed of labeled data \((x_i, y_i)\), which can be used to train a reliable classifier. The target domain is composed of unlabeled data \(y^* = (y^*_i)\), whose statistical properties are different. In this work, we propose an algorithm for adapting the model (e.g., classifier) trained on the source domain to the target domain. A real-world example

Figure 1: An example of domain adaptation problem in image classification. Monitor images from four domains: the source domain and the target domain. The source domain is the image dataset from the target domain.

Performance of kernel-based learning machines highly depends on the statistical properties of data in reproducing kernel Hilbert spaces (RKHS). Most existing methods attempt to align the data distributions in RKHS. However, in these methods, the statistical difference in RKHS cannot be well controlled. To overcome this issue, we propose a framework of aligning data distributions in RKHS. The proposed framework also possesses out-of-sample generalizability and computational efficiency.

![Image](image_url)

**Figure 2:** (a) The source samples transformed by the optimal transport map (i.e., \(\mathbf{OT}\) map [3], i.e., \(\mathbf{OT}_{\mathbf{X}} = \mathbf{Φ}_{\mathbf{X}}\mathbf{Ψ}_{\mathbf{X}}\)). (b) The centered source data, \(\mathbf{Σ}_1\mathbf{X}\), \(\mathbf{Σ}_2\mathbf{X}\), and centered target data, \(\mathbf{Σ}_1\mathbf{Y}\), \(\mathbf{Σ}_2\mathbf{Y}\), in the RKHS. (c) Transform the source samples by the map \(\mathbf{OT}\) map is given by \(\mathbf{OT}_{\mathbf{X}} = \mathbf{Φ}_{\mathbf{X}}\mathbf{Ψ}_{\mathbf{X}}\), where \(\mathbf{σ}_1\mathbf{Φ}_{\mathbf{X}}\mathbf{Ψ}_{\mathbf{X}}\mathbf{σ}_1\) and \(\mathbf{σ}_2\mathbf{Φ}_{\mathbf{X}}\mathbf{Ψ}_{\mathbf{X}}\mathbf{σ}_2\) are positive eigenpairs of \(\mathbf{C}_{\mathbf{XY}}\).

**Observation:** Our methods KWC and KOT outperform the baseline methods in most cases.

**References**

