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On distribution distance in a transfer learning context for virtual metrology

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In semiconductor manufacturing, Virtual Metrology (VM) refers to the task performed to predict post-process metrology variables based on machine settings and sensor data. To improve the efficiency of a VM system, the paradigm of transfer learning is used to leverage the knowledge extracted when exploiting a source domain of a source task, by applying it to a new task and/or new domain. The majority of VM systems rely on machine learning based solution approaches under the assumption that the training and the testing datasets are drawn from the same domain, such that the data distributions are the same. However, in real life manufacturing contexts, this assumption does not always hold. For instance, this is the case when a VM system is applied on a tool subject to a shift, or on a new chamber. To circumvent this issue, distribution shift adaptation approaches are developed to align a model trained in a source domain to a new domain. This work studies the distance between the source and target domains to support the transfer learning for VM. The first part of the work is devoted to the definition of the distribution discrepancy/similarity between domains via a range of metrics and their optimization. The second part of the work applies statistical distribution adaptation methods, such as conditional distribution alignment approach, to support the transfer learning for a virtual metrology task. Numerical experiments are conducted on a benchmark dataset provided by the Prognostic and Health Management completion in 2016.

Keywords

Virtual Metrology, Transfer Learning

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