# Enriching Non-Parametric Models for Practical Robot Policies

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## Abstract

Robotic control policies must handle complex tasks in dynamic environments, yet traditional parametric and non-parametric models face significant limitations. Semi-parametric models combine their strengths but often struggle with multimodality, local discontinuities, and low-probability behaviors. This work enhances semi-parametric models by advancing their non-parametric components with Bayesian techniques to improve adaptability, accuracy and efficiency. We propose two novel approaches: (1) **Composite Gaussian Processes Flows (CGP-Flows)**, which integrate Overlapping Mixtures of Gaussian Processes (OMGPs) and Non-Gaussian Gaussian Processes (NGGPs) to model multimodality. These composite distributions are transformed using Conditional Continues Normalizing Flows (CCNFs) to handle smoothness and local discontinuities, achieving a balance between computational efficiency and expressiveness for non-linear tasks. (2) **Model Select Gaussian Processes Flows (MSGP-Flows)**, which combine Robust Gaussian Processes (RGPs) and NFs to assign lower weights to low-probability modes in multimodal data. This approach reduces the impact of rare actions while retaining diverse expert strategies, improving learning efficiency.