# Discrete-time Contraction Constrained Nonlinear Model Predictive Control using Graph-based Geodesic Computation

Lai Wei[1], Ryan McCloy[1], Jie Bao[1], and Jesse Cranney[2]

[1]University of New South Wales
[2]Australian National University

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**Abstract**

Modern chemical processes need to be operated around different operating conditions to optimize plant economy, in response to dynamic supply chains. As such, the process control system needs to handle a wide range of operating conditions whilst optimizing system performance and ensuring stability during transitions. This article presents a reference-flexible nonlinear model predictive control approach using contraction based constraints. Firstly, a contraction condition that ensures convergence to any feasible state trajectories or setpoints is constructed. This condition is then imposed as a constraint on the optimization problem for model predictive control with a general (typically economic) cost function, utilizing Riemannian weighted graphs and shortest path techniques. The result is a reference flexible and fast optimal controller that can trade-off between the rate of target trajectory convergence and economic benefit (away from the desired process objective). The proposed approach is illustrated by a simulation study on a CSTR control problem.