

A Singularity-free Path Planner for Closed-chain Manipulators



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1. INTRODUCTION

2. THE METHOD

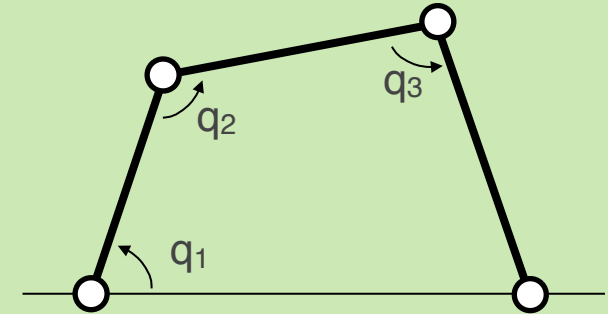
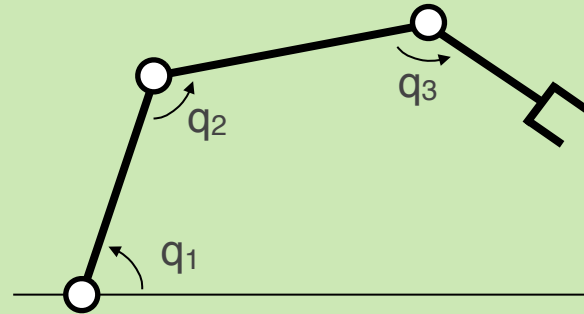
3. EXAMPLES

4. CONCLUSION

OPEN - CHAIN

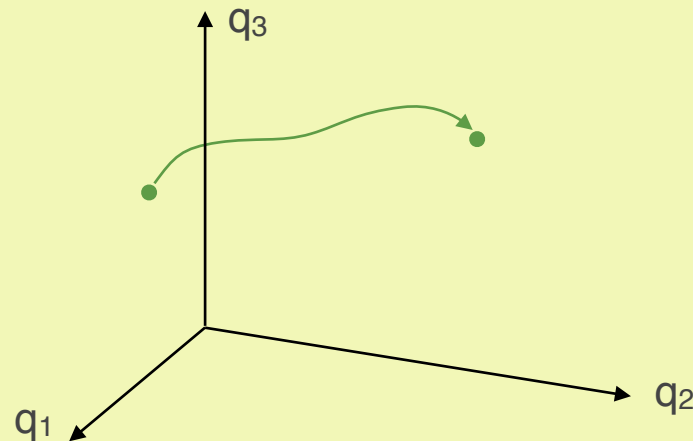
CLOSED - CHAIN

ROBOT EXAMPLE

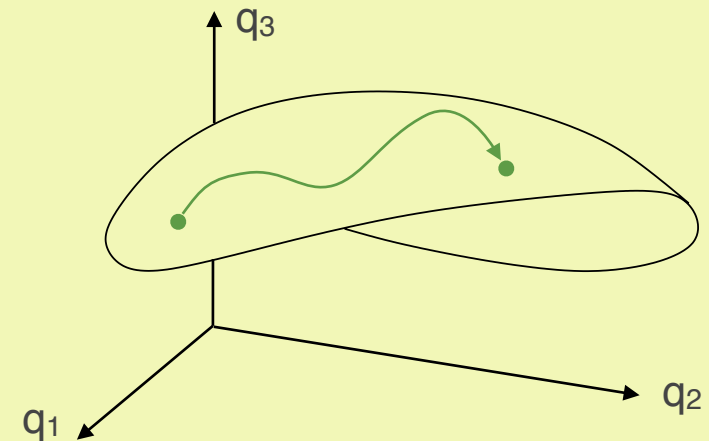


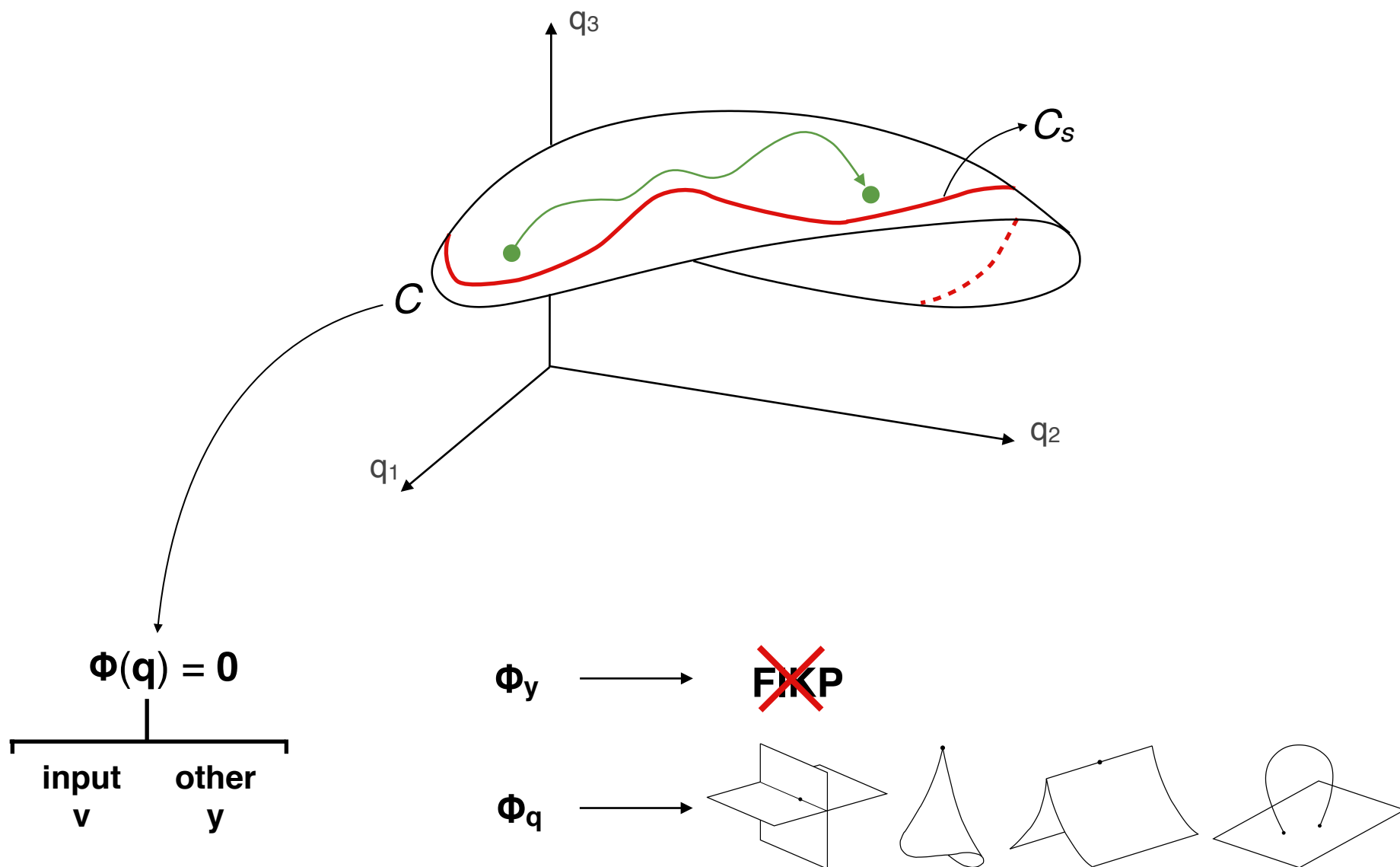
CONFIGURATION SPACE

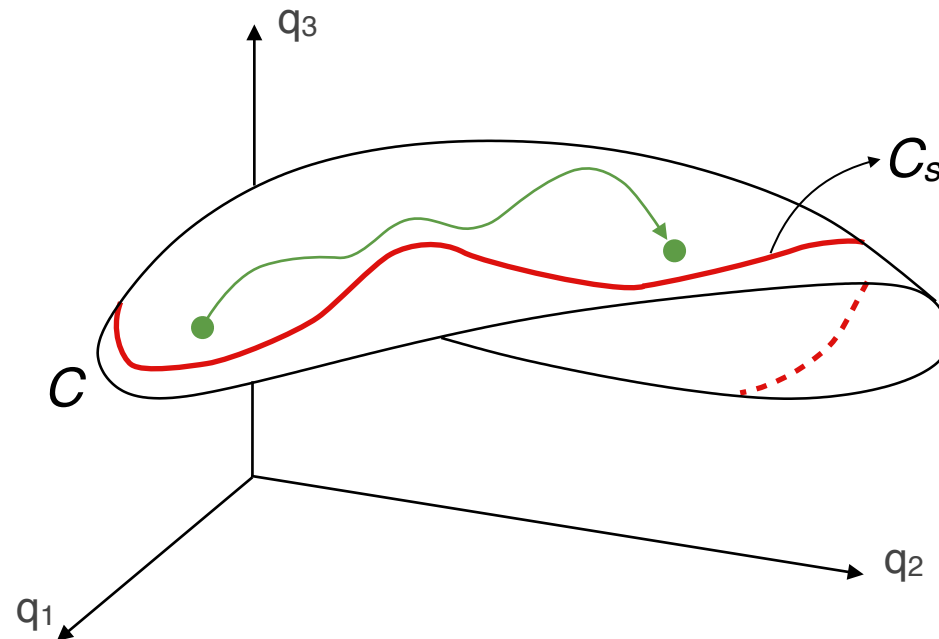
PARAMETRICALLY DEFINED



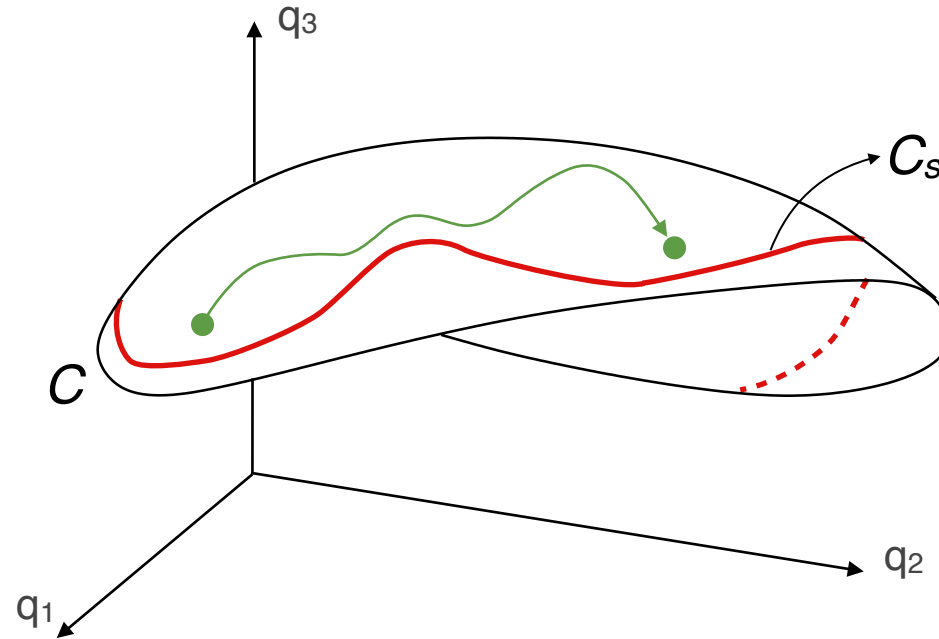
IMPLICITLY DEFINED







Dasgupta & Mruthyunjaya	1998	deform a parametrized path
Sen, Dasgupta & Mallik	2003	variational approach
Dash, Chen et al.	2005	singularities as obstacles



NAVIGATE
 $C_{\text{free}} = C \setminus C_s$

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2. THE METHOD

2.1 A SYSTEM OF EQUATIONS FOR C_{sfree}

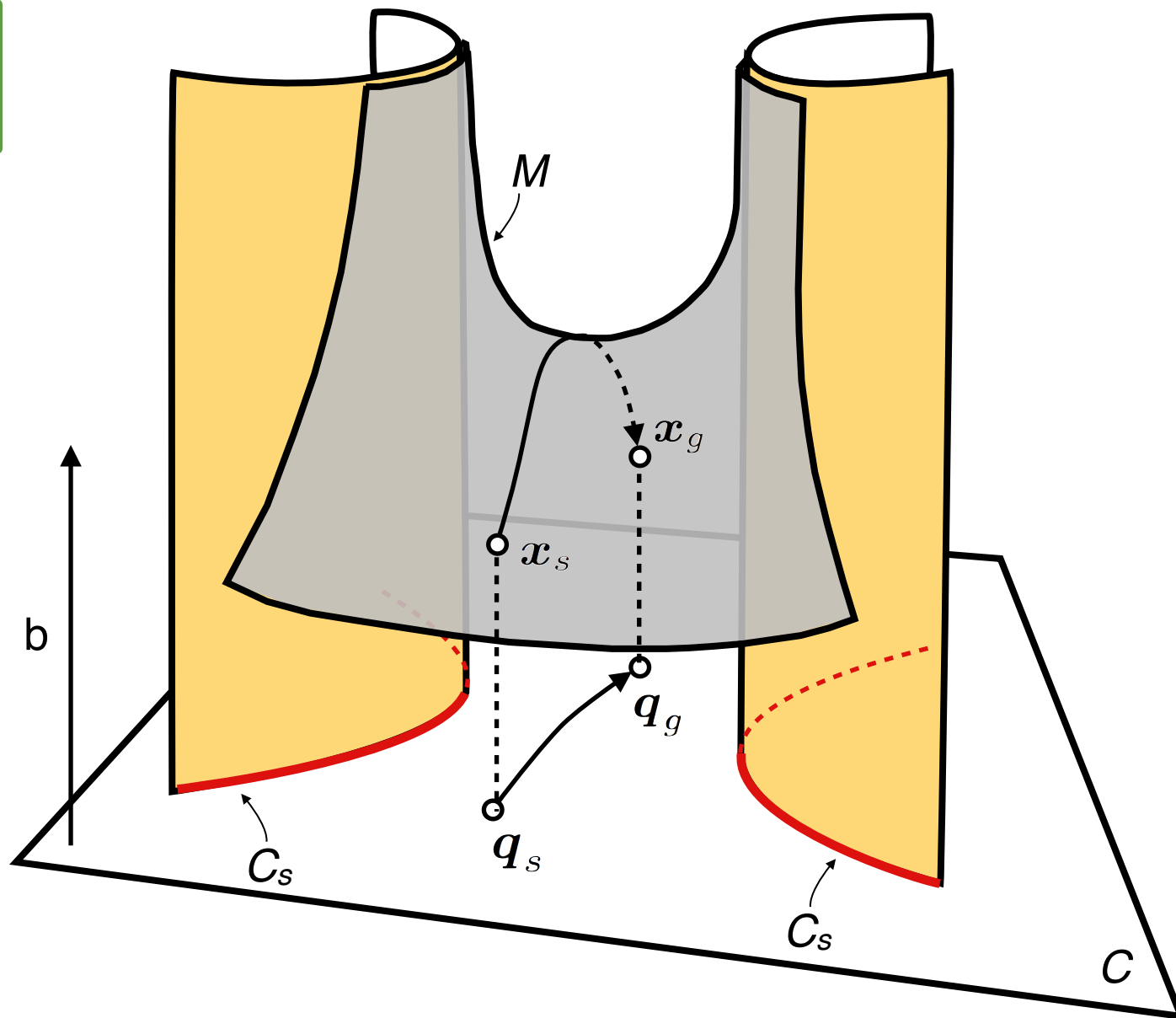
2.2 EXPLORING C_{sfree} FOR A PATH

3. EXAMPLES

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$$\Phi(q) = 0$$

$$\det(\Phi_y) \cdot b = 1$$



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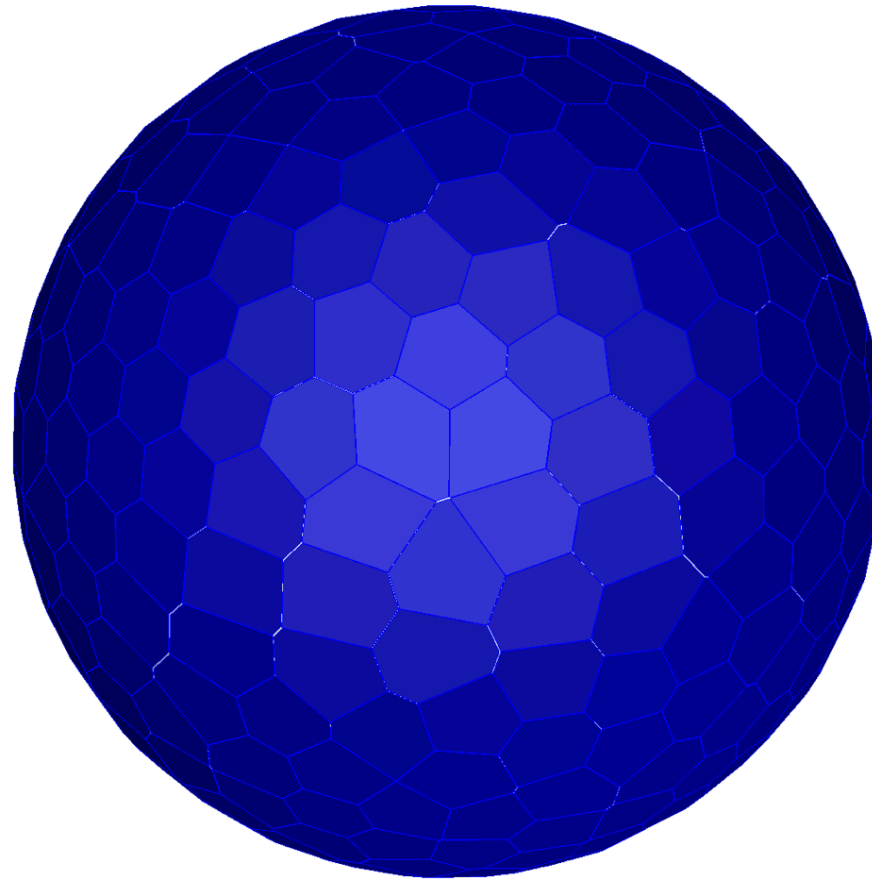
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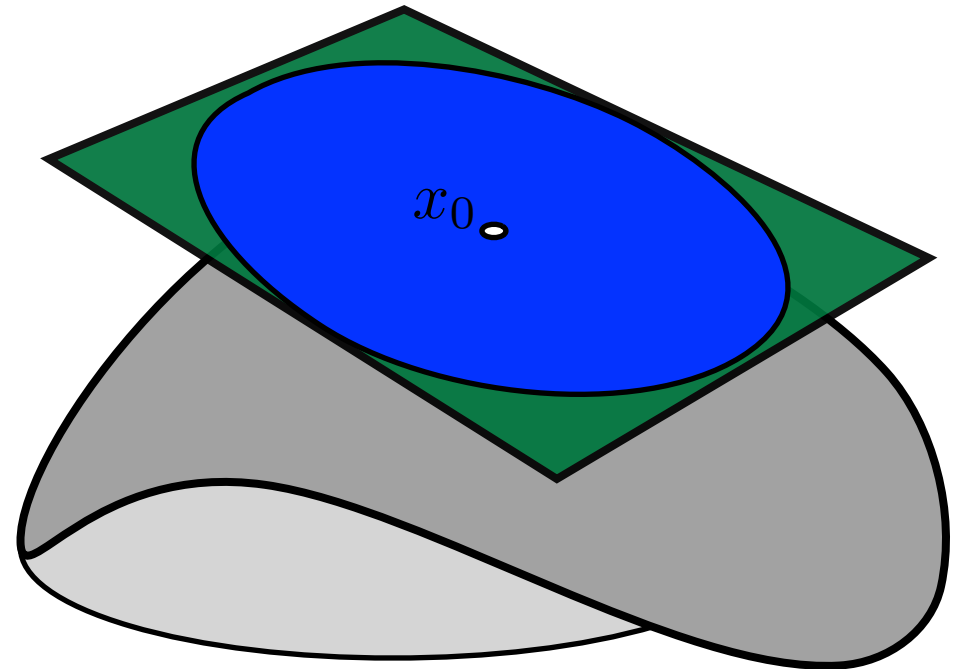
HIGHER-DIMENSIONAL CONTINUATION



ITERATIVELY BUILDS THE **CHARTS** OF THE **ATLAS** FROM A STARTING POINT

HIGHER-DIMENSIONAL CONTINUATION

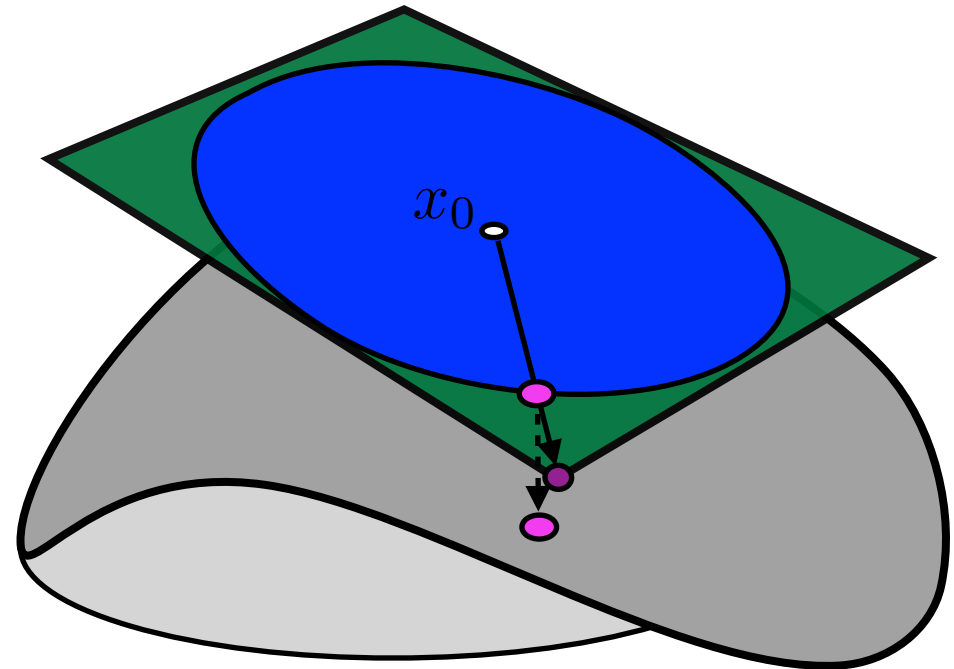
INITIALIZE CHART



HIGHER-DIMENSIONAL CONTINUATION

INITIALIZE CHART

SELECT POINT AND PROJECT

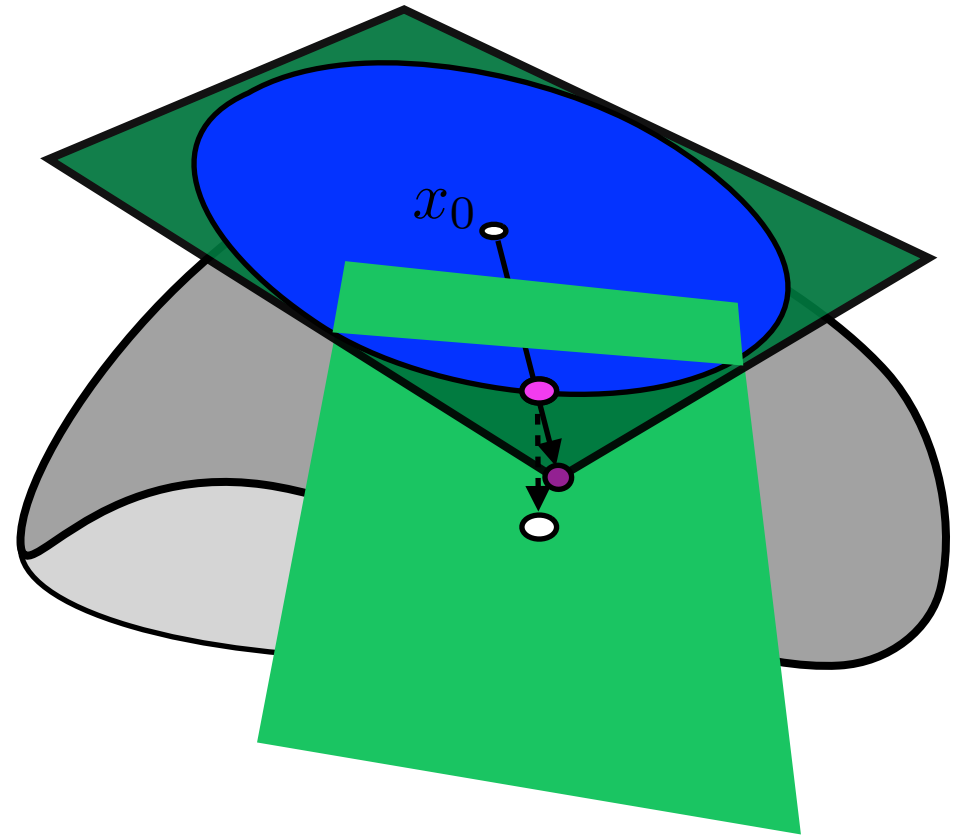


HIGHER-DIMENSIONAL CONTINUATION

INITIALIZE CHART

SELECT POINT AND PROJECT

TEST VALIDITY OF NEW CHART



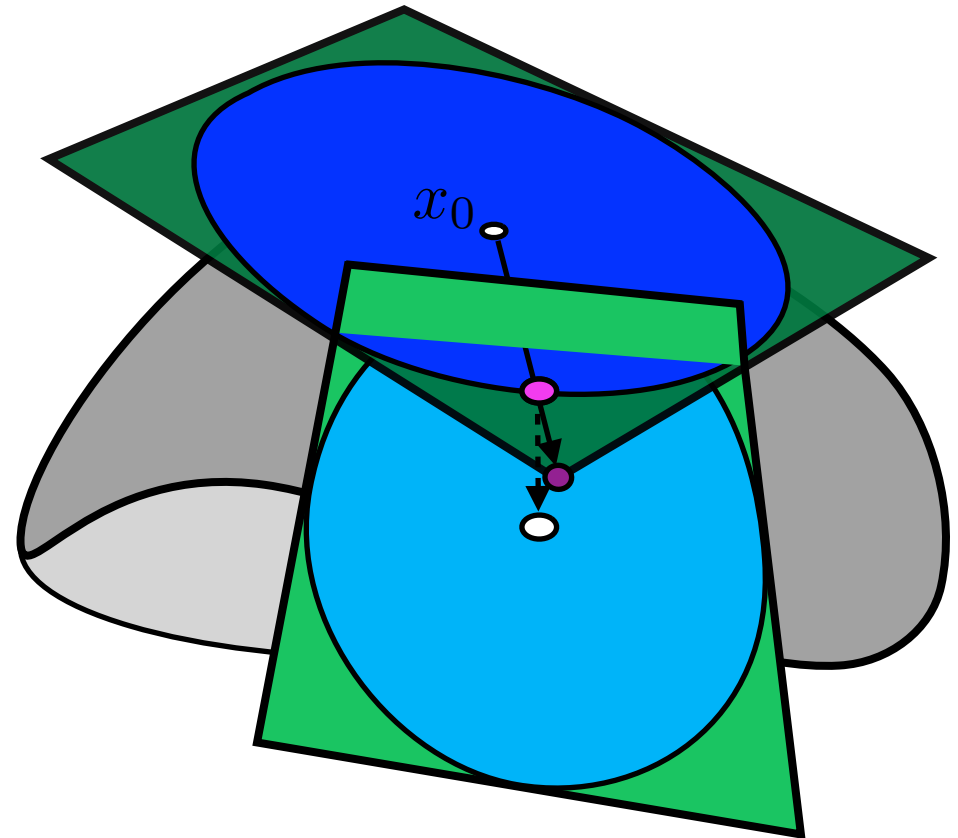
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INITIALIZE CHART

SELECT POINT AND PROJECT

TEST VALIDITY OF NEW CHART

INITIALIZE NEW CHART



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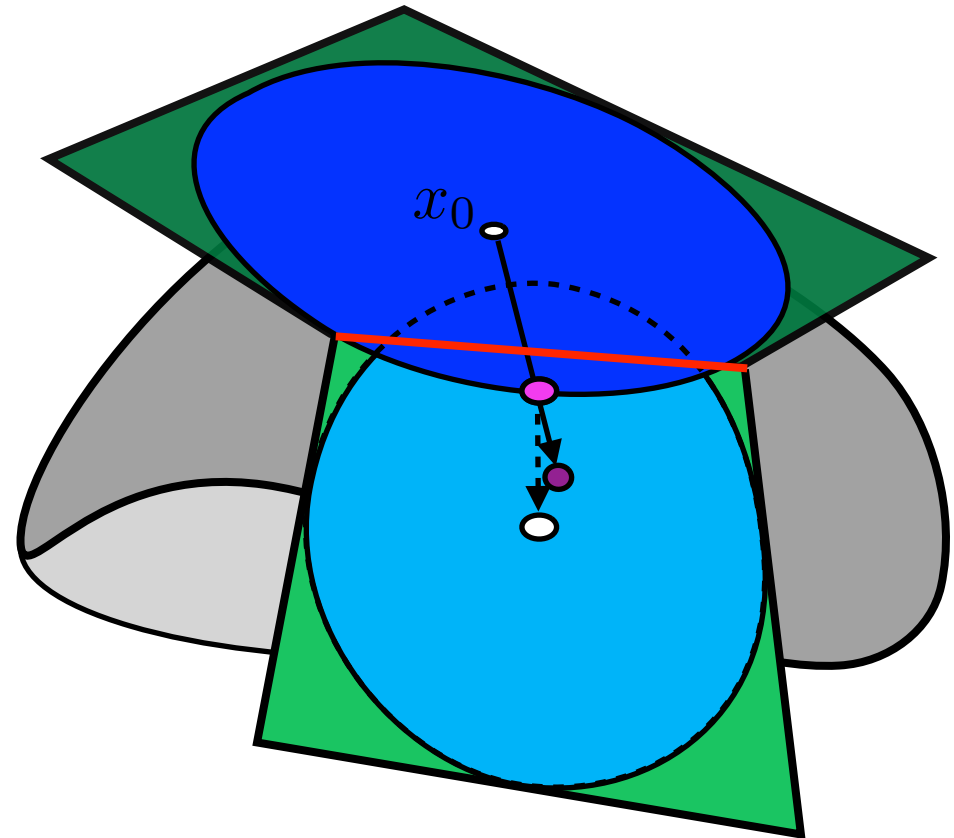
INITIALIZE CHART

SELECT POINT AND PROJECT

TEST VALIDITY OF NEW CHART

INITIALIZE NEW CHART

CROP THE CHARTS



HIGHER-DIMENSIONAL CONTINUATION

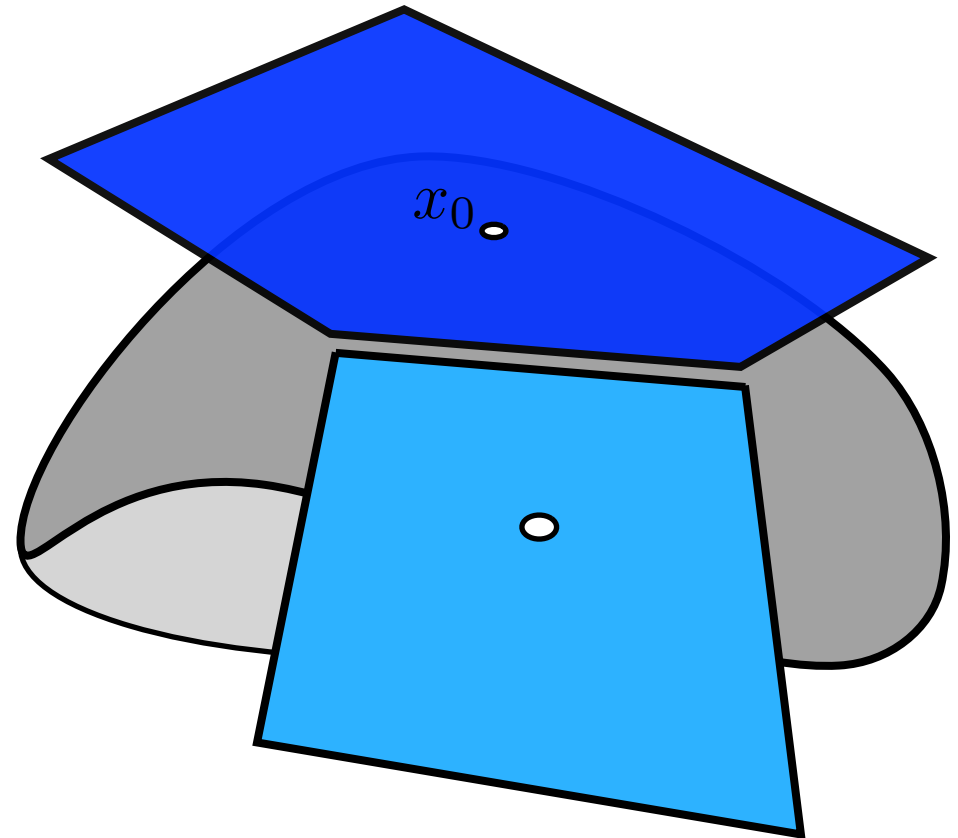
INITIALIZE CHART

SELECT POINT AND PROJECT

TEST VALIDITY OF NEW CHART

INITIALIZE NEW CHART

CROP THE CHARTS



HIGHER-DIMENSIONAL CONTINUATION

INITIALIZE CHART

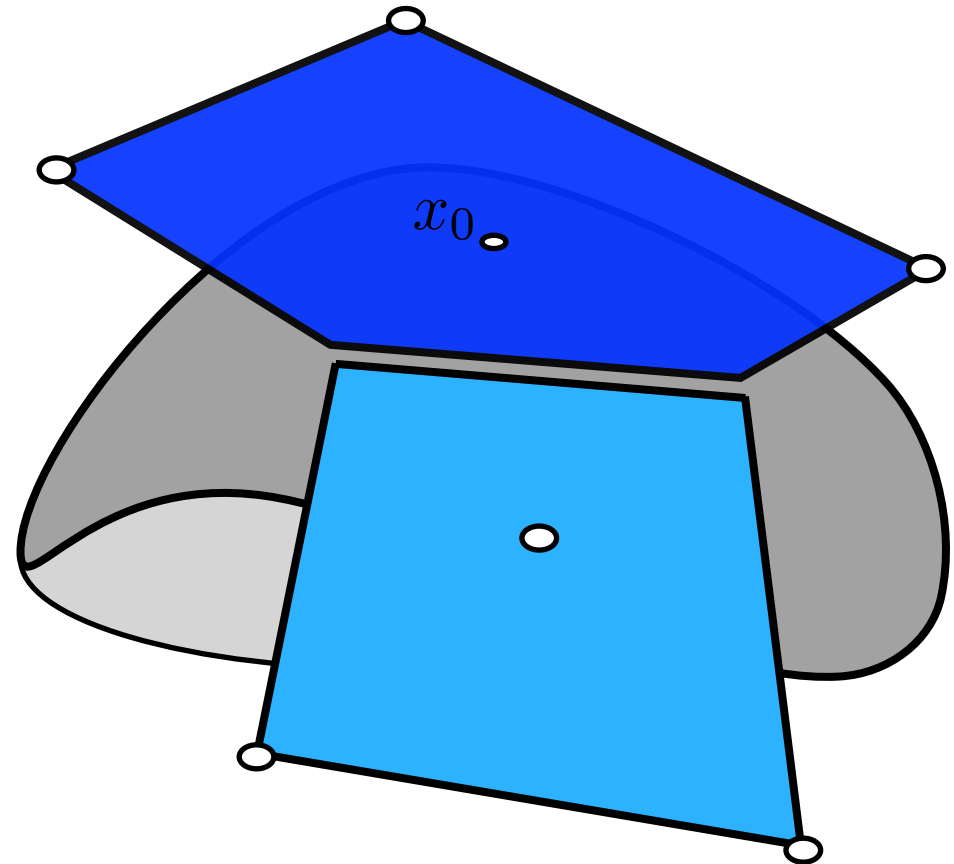
SELECT POINT AND PROJECT

TEST VALIDITY OF NEW CHART

INITIALIZE NEW CHART

CROP THE CHARTS

EXPAND THE ATLAS

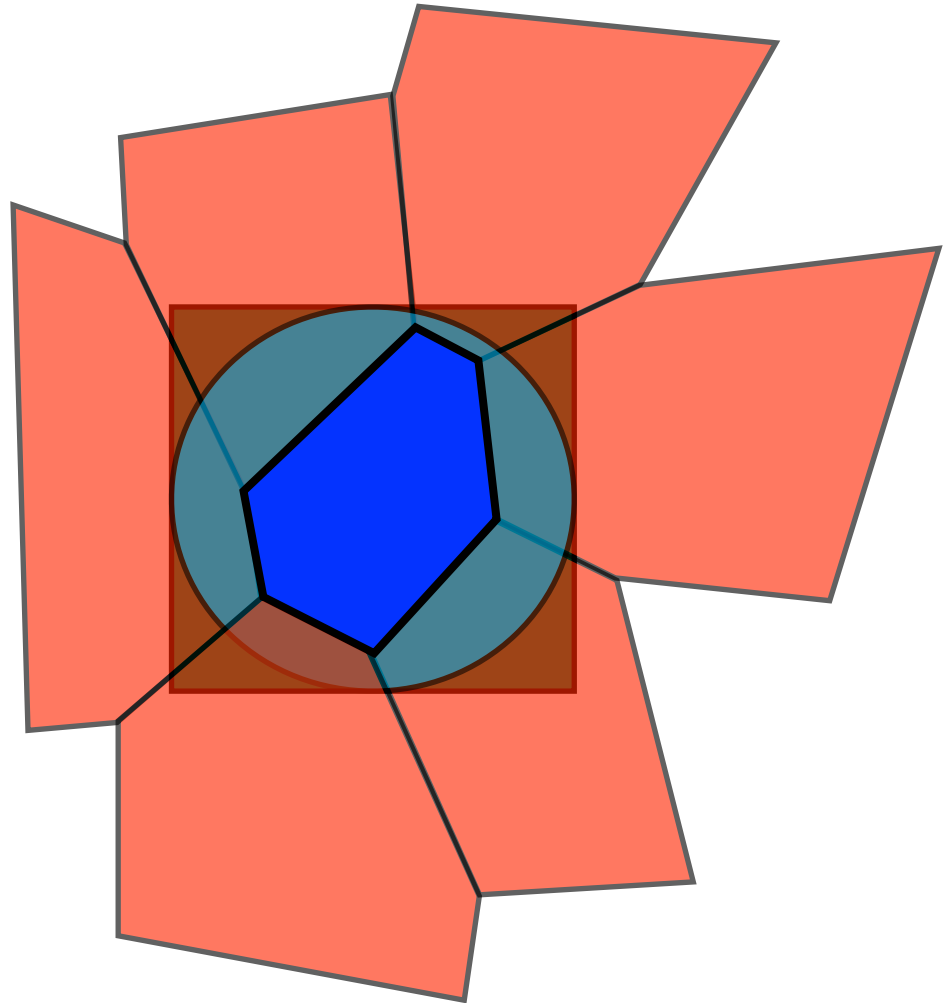


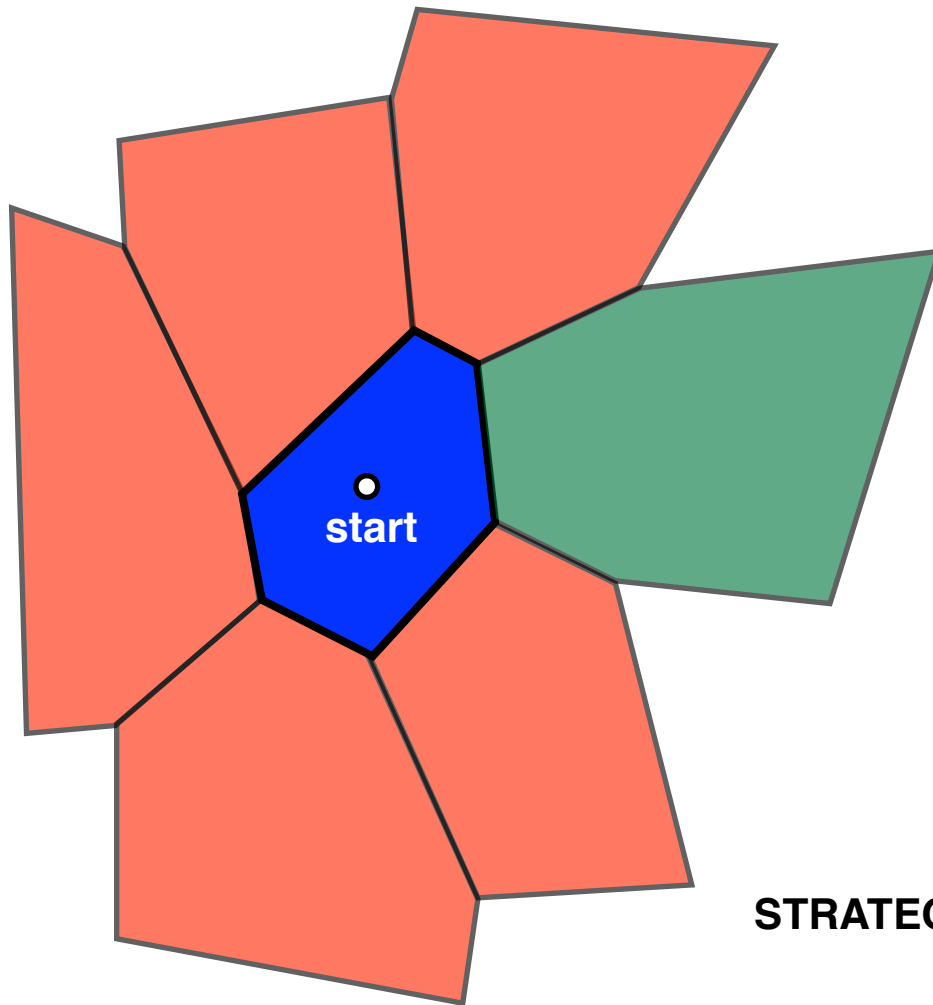
HIGHER-DIMENSIONAL CONTINUATION

NEIGHBOUR CHARTS CROP THE POLYTOPE

POLYTOPE INSIDE THE BALL

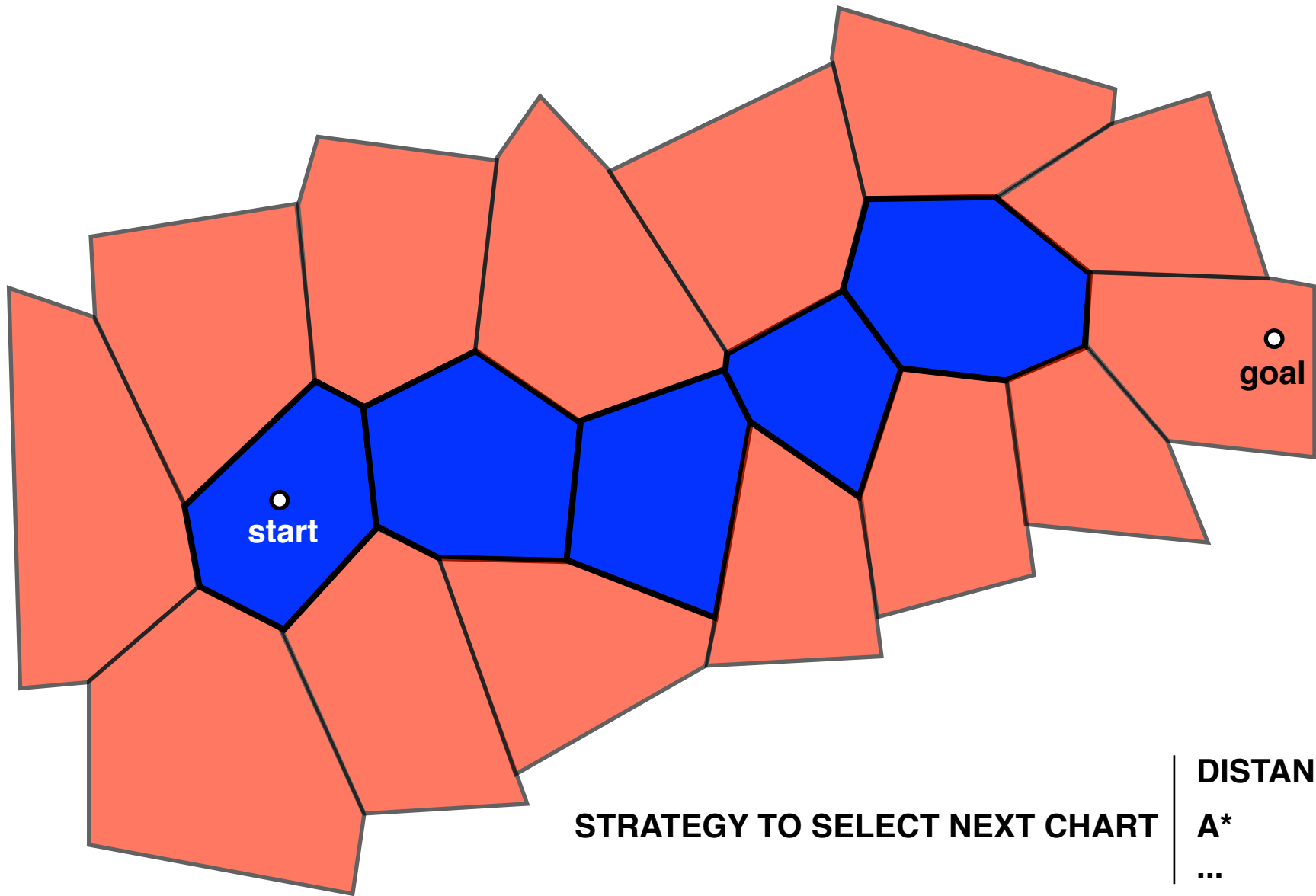
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CHART CLOSED





STRATEGY TO SELECT NEXT CHART

DISTANCE



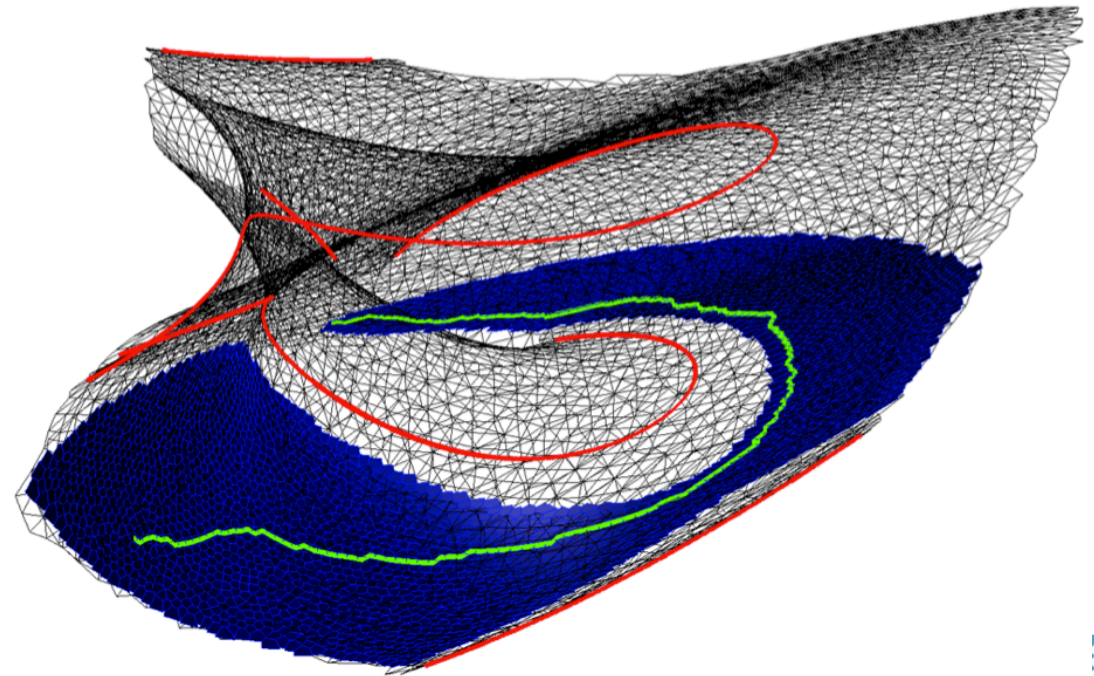
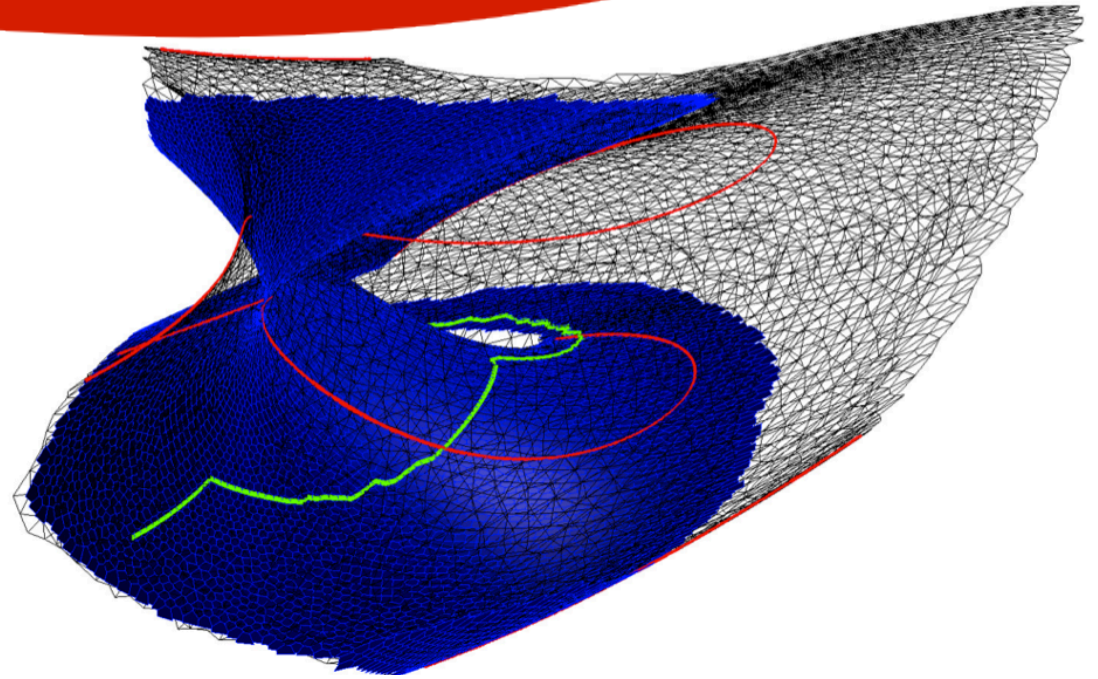
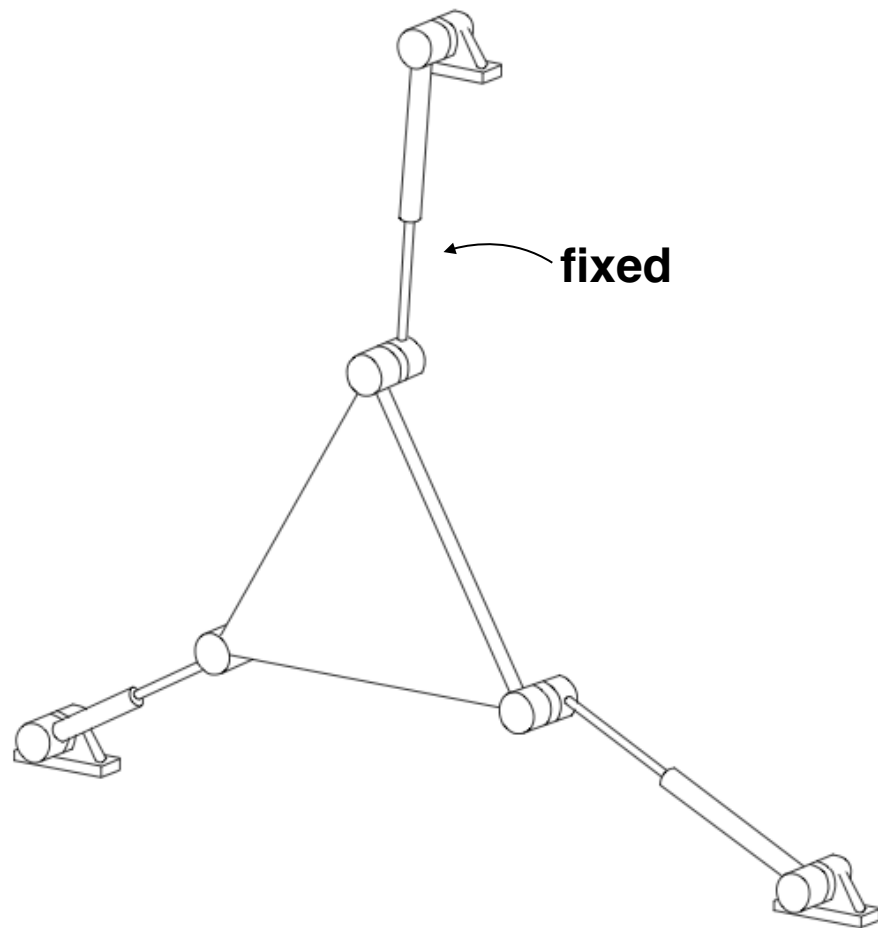
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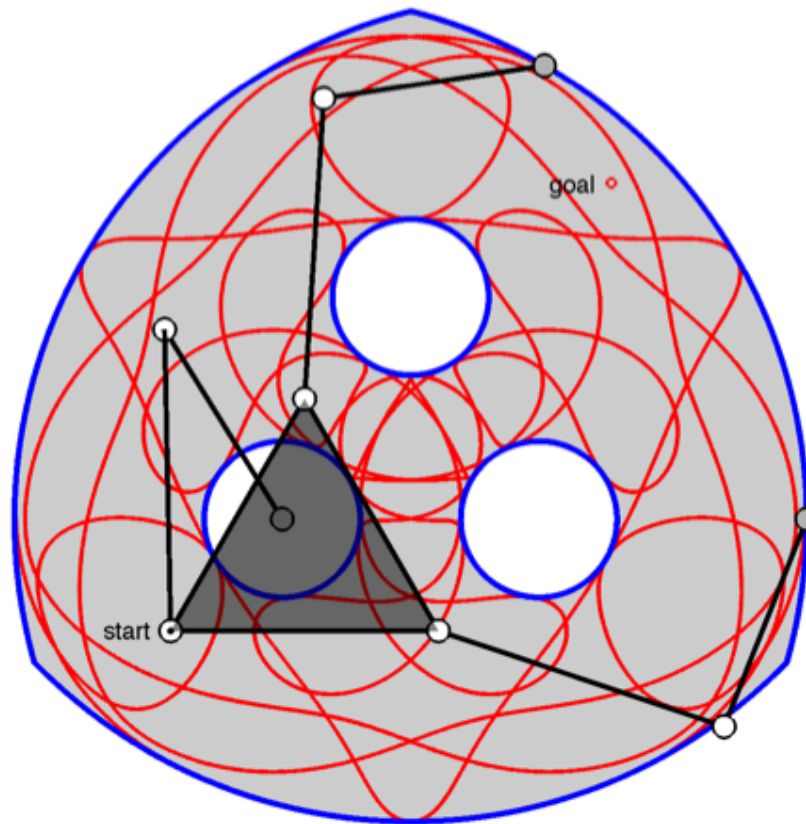
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3RPR

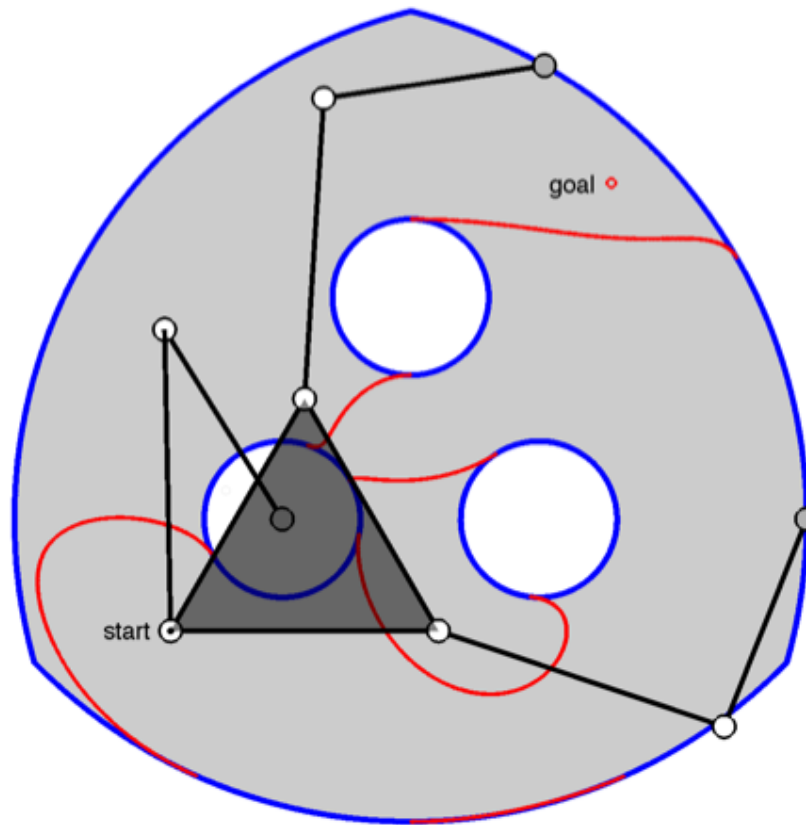


3RRR CONSTANT ORIENTATION



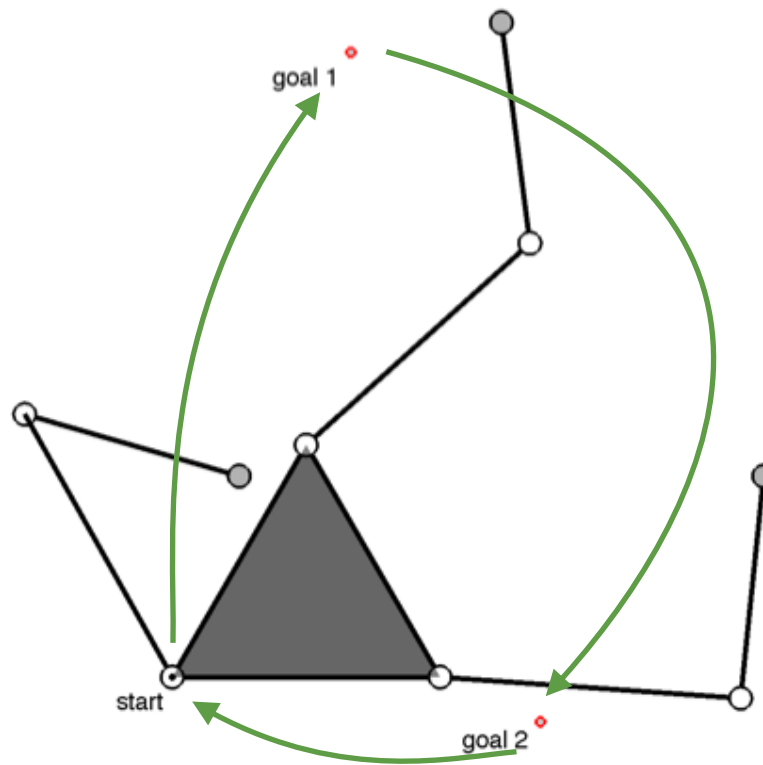
3RRR CONSTANT ORIENTATION

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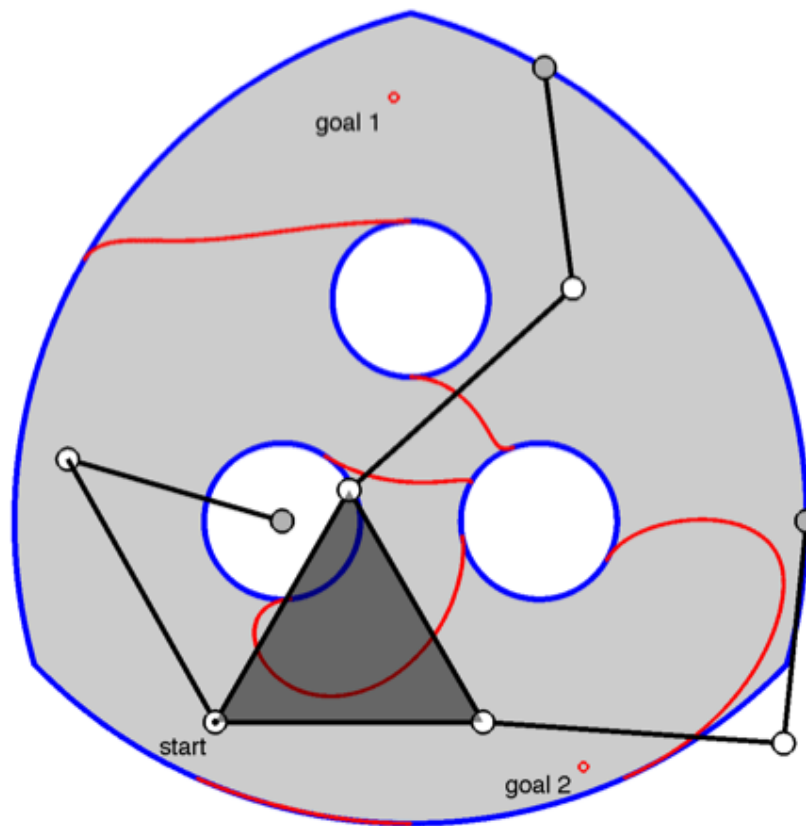
3RRR

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3RRR

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APPROACH TO COMPUTE SINGULARITY-FREE PATHS ON NON-REDUNDANT MANIPULATORS

NO PARAMETRIZATIONS

NO EXPLICIT REPRESENTATION
OF SINGULARITY LOCUS

HIGHER-DIMENSIONAL
CONTINUATION

AVOID OTHER KIND OF
SINGULARITIES

TREATMENT OF MANIPULATOR
COLLISIONS CAN BE
INCORPORATED

