

# INTERACTIVE MOTION PLANNING WITH CONTACT

Nassime BLIN

*sous la direction de*

Michel TAÏX

Philippe FILLATREAU

Jean-Yves FOURQUET

LAAS-CNRS/LGP-ENIT INP Toulouse



- 1 Introduction
- 2 Interactive Motion Planning
- 3 Contact Planning
- 4 Tests
- 5 Conclusion

# INTRODUCTION

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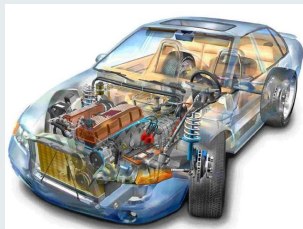
## SUMMARY

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# INTRODUCTION

## Context : Product Lifecycle management (PLM)

- Assembly
- Disassembly
- Maintenance



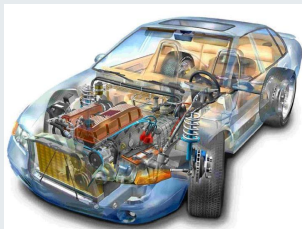
## Virtual Reality (VR)

- Automatisation
- Costs reduction

# INTRODUCTION

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# INTRODUCTION

## MOTION PLANNING

### Different Methods

- Determinist algorithms
- Probabilistic Algorithms : PRM, RRT
- Interactive Motion Planning

### Contribution

- RRT-based Interactive Motion Planning algorithm with Contact Sampling on obstacles

# INTRODUCTION

## MOTION PLANNING

### Different Methods

- Determinist algorithms
- Probabilistic Algorithms : PRM, RRT
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### Contribution

- RRT-based Interactive Motion Planning algorithm with Contact Sampling on obstacles

# INTERACTIVE MOTION PLANNING

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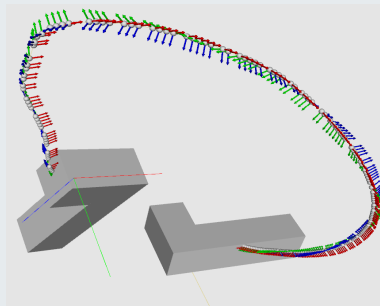
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# INTERACTIVE MOTION PLANNING

DEVICE

## Interaction between an operator and an RRT



# INTERACTIVE MOTION PLANNING

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## ALGORITHM

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### Algorithm 1 Interactive Motion Planning

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```
1: loop
2:    $a \leftarrow \text{rand}(0, 1)$ 
3:   if  $a > \alpha$  then
4:      $q_{\text{current}} \leftarrow q_{\text{device}}$ 
5:      $T \leftarrow \text{Add\_Tree}(q_{\text{current}})$ 
6:   else
7:      $q_{\text{current}} \leftarrow \text{Random\_Shooter}()$ 
8:      $T \leftarrow \text{Add\_Tree}(q_{\text{current}})$ 
9:   end if
10: end loop
```

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# CONTACT PLANNING

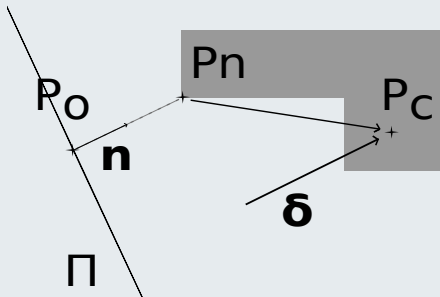
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# CONTACT PLANNING

## Interaction between RRT and an operator



## Variables

- $n$  is the normal vector to surface  $\Pi$
- $\delta$  is the distance from  $P_n$  to  $P_c$  along  $n$

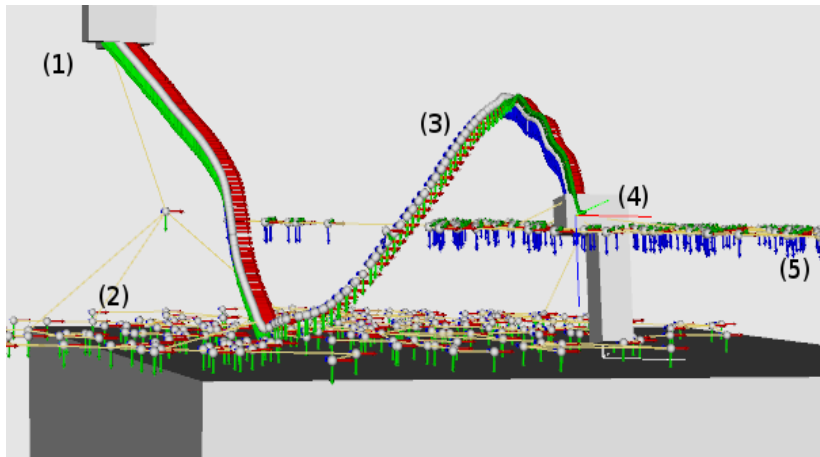
# CONTACT PLANNING

## MOTION PLANNING WITH INTERACTION AND CONTACT

```
1: loop
2:    $(P_o, P_n) = \text{Find\_Nearest\_Obstacle}(q_{device})$ 
3:    $a \leftarrow \text{rand}(0, 1)$ 
4:   if  $a > \alpha$  then
5:     if  $|P_c - P_n| \geq d$  then
6:        $q_{current} \leftarrow q_{device}$ 
7:        $T \leftarrow \text{Add\_Tree}(q_{current})$ 
8:     else
9:        $\text{ContactSampling}(P_o, P_n, N, q_{device})$ 
10:    end if
11:  else
12:     $q_{current} \leftarrow \text{Random\_Shooter}()$ 
13:     $T \leftarrow \text{Add\_Tree}(q_{current})$ 
14:  end if
15: end loop
```

# CONTACT PLANNING

## EXAMPLE : TWO SUCCESSIVE CONTACTS



# TESTS

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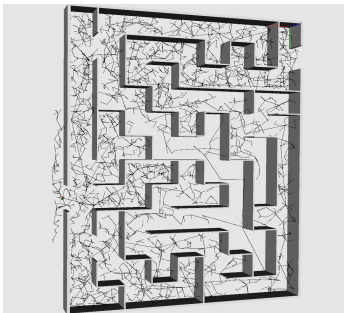
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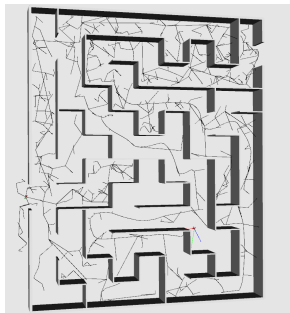
# TESTS

## EXAMPLE SPACE : MAZE

Simple RRT :



Interactive RRT :

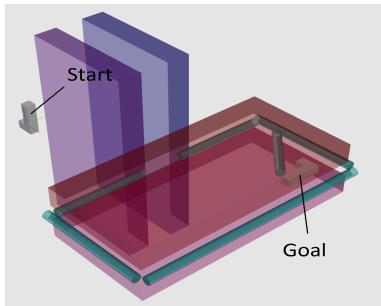




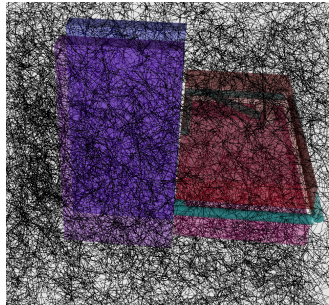
# TESTS

## CONSTRAINED ENVIRONMENT

Environment :



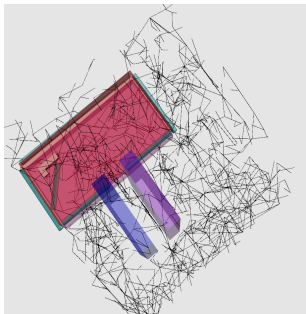
Simple RRT :



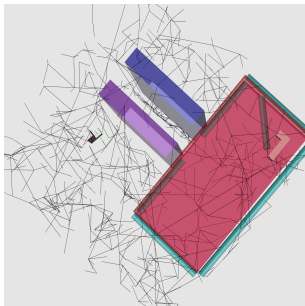
# TESTS

## INFLUENCE OF ALPHA

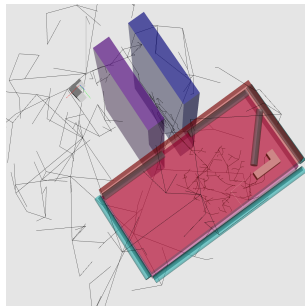
$\alpha = 0.8$



$\alpha = 0.2$

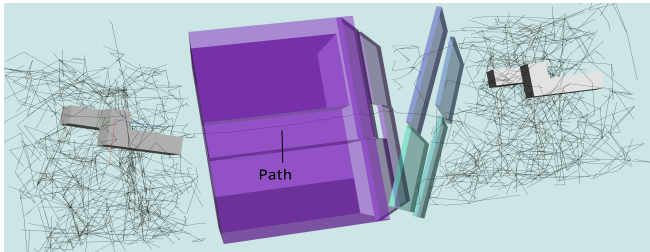
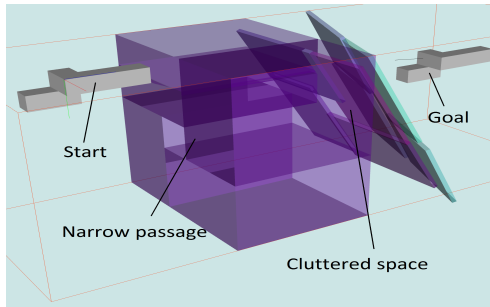


$\alpha = 0.05$



# TESTS

## VERY CONSTRAINED ENVIRONMENT



# CONCLUSION

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## New Path planning method

- Interactive guidance
- Contact Sampling

## Future work

- Randomly change orientation
- Follow different contacts

Merci !

Thank you !