

Configuration YAML File Specification:

Version 2

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I. INTRODUCTION

The configuration file is composed of three elements: *vfi_file_version*, *zero_indexed*, and *vfi_array*. The former defines the version, whereas the second is used to support zero-indexed configuration parameters (i.e., to determine if the minimum *joint_index* or *robot_index* is 0 or 1). Finally, the *vfi_array* contains the parameters used to build all VFI constraints. Version 1 (V1) refers to the configuration files used by SAS,¹ in which in the *vfi_array*, the minimum *joint_index* or *robot_index* is always 0, and some parameters defined in this document are optional. Version 2 (V2) refers to the specifications described in this document, in which all parameters are mandatory.

The VFIs can be of two types "ENVIRONMENT_TO_ROBOT" or "ROBOT_TO_ROBOT", which each type contain specific parameters. For instance, the "ROBOT_TO_ROBOT" type adds three additional parameters. Tables I and II show the parameters required in the *vfi_array*.

Some type of primitives could require more than one CoppeliaSim object to be described. For instance, the "LINESEGMENT" require three objects to describe the line, and the two points on the line that compose the line segment. The description must be written in a specific order: first, the object that defines the line, and then the

objects representing the two points on the line. Figure 2 shows a complete example.

```
vfi_file_version: 2
zero_index: false
vfi_array:
  -
    vfi_type: "ENVIRONMENT_TO_ROBOT"
    vfi_gain: 1.0
    tag: "C1"
  -
    vfi_type: "ROBOT_TO_ROBOT"
    vfi_gain: 1.0
    tag: "C2"
```

Fig. 1. Example of the configuration file structure

¹https://github.com/AISciencePlatform/aisp_ros_control_template/blob/main/cfg/aisp_kinematics.yaml

TABLE I
VFI_ARRAY: CONFIGURATION PARAMETERS FOR "ENVIRONMENT_TO_ROBOT" VFI TYPES.

Parameter	Description/Possible Values	Type	V1
vfi_type	$d_{\text{type}} \in \{\text{"ENVIRONMENT_TO_ROBOT"}, \text{"ROBOT_TO_ROBOT"}\}$	string	
cs_entity_environment	["coppeliasm_object_name"]	string list	
cs_entity_robot	["coppeliasm_object_name_attached_to_the_robot"]	string list	
entity_environment_primitive_type	$p \in \{\text{"LINE"}, \text{"POINT"}, \text{"PLANE"}, \text{"LINESEGMENT"}, \text{"LINEANGLE"}\}$	string	
entity_robot_primitive_type	$p \in \{\text{"LINE"}, \text{"POINT"}, \text{"PLANE"}, \text{"LINESEGMENT"}, \text{"LINEANGLE"}\}$	string	
robot_index	$r_i \in [a, \infty)$, where $a \in \{0, 1\}$ according to the zero-indexed flag	int	$a = 0$
joint_index	$i \in [a, \infty)$, where $a \in \{0, 1\}$ according to the zero-indexed flag	int	$a = 0$
safe_distance	$d_{\text{safe}} \in (0, \infty)$	double	
vfi_gain	$\eta \in (0, \infty)$	double	Optional
direction	$d_{\text{type}} \in \{\text{"RESTRICTED_ZONE"}, \text{"SAFE_ZONE"}\}$	string	
tag	"tag_of_the_vfi"	string	Optional

TABLE II
VFI_ARRAY: CONFIGURATION PARAMETERS FOR "ROBOT_TO_ROBOT" VFI TYPES.

Parameter	Description/Possible Values	Type	V1
vfi_type	$d_{\text{type}} \in \{\text{"ENVIRONMENT_TO_ROBOT"}, \text{"ROBOT_TO_ROBOT"}\}$	string	
cs_entity_one	["coppeliasm_object_name_attached_to_the_robot_1"]	string list	
cs_entity_two	["coppeliasm_object_name_attached_to_the_robot_2"]	string list	
entity_one_primitive_type	$p \in \{\text{"LINE"}, \text{"POINT"}, \text{"PLANE"}, \text{"LINESEGMENT"}, \text{"LINEANGLE"}\}$	string	
entity_two_primitive_type	$p \in \{\text{"LINE"}, \text{"POINT"}, \text{"PLANE"}, \text{"LINESEGMENT"}, \text{"LINEANGLE"}\}$	string	
robot_index_one	$r_{1_i} \in [a, \infty)$, where $a \in \{0, 1\}$ according to the zero-indexed flag	int	$a = 0$
robot_index_two	$r_{2_i} \in [a, \infty)$, where $a \in \{0, 1\}$ according to the zero-indexed flag	int	$a = 0$
joint_index_one	$i_1 \in [a, \infty)$, where $a \in \{0, 1\}$ according to the zero-indexed flag	int	$a = 0$
joint_index_two	$i_2 \in [a, \infty)$, where $a \in \{0, 1\}$ according to the zero-indexed flag	int	$a = 0$
safe_distance	$d_{\text{safe}} \in (0, \infty)$	double	
vfi_gain	$\eta \in (0, \infty)$	double	Optional
direction	$d_{\text{type}} \in \{\text{"RESTRICTED_ZONE"}, \text{"SAFE_ZONE"}\}$	string	
tag	"tag_of_the_vfi"	string	Optional

```

vfi_file_version: 2
zero_indexed: false
vfi_array:
  -
    vfi_type: "ENVIRONMENT_TO_ROBOT"
    cs_entity_environment: ["Cylinder_1"]
    cs_entity_robot: ["Sphere_1"]
    entity_environment_primitive_type: "LINE"
    entity_robot_primitive_type: "POINT"
    robot_index: 1
    joint_index: 1
    safe_distance: 0.180625
    vfi_gain: 1.0
    direction: "RESTRICTED_ZONE"
    tag: "C1"
  -
    vfi_type: "ROBOT_TO_ROBOT"
    cs_entity_one: ["Cobotta1_vfi_sphere_0_1"]
    cs_entity_two: ["Densol_VS050_vfi_sphere_0_1"]
    entity_one_primitive_type: "POINT"
    entity_two_primitive_type: "POINT"
    robot_index_one: 1
    robot_index_two: 2
    joint_index_one: 1
    joint_index_two: 1
    safe_distance: 0.16
    vfi_gain: 1.0
    direction: "RESTRICTED_ZONE"
    tag: "C2"
  -
    vfi_type: "ROBOT_TO_ROBOT"
    cs_entity_one: ["line_1", "sphere_1_0", "sphere_1_1"]
    cs_entity_two: ["line_2", "sphere_2_1", "sphere_2_2"]
    entity_one_primitive_type: "LINESEGMENT"
    entity_two_primitive_type: "LINESEGMENT"
    robot_index_one: 1
    robot_index_two: 2
    joint_index_one: 7
    joint_index_two: 7
    safe_distance: 0.01
    vfi_gain: 1.0
    direction: "RESTRICTED_ZONE"
    tag: "C3"

```

Fig. 2. Example of a complete configuration file.