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TECHNICAL CORRIGENDUM 1

Industrial automation systems and integration- Product data representation and exchange - Part 105: Application resource: Kinematics

TECHNICAL CORRIGENDUM 1

Technical Corrigendum 1 to International Standard ISO 10303-105: 1996 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 4, *Industrial data*.

Included SEDS reports: 229, 230, 231, 232, 378, 380, 381, 382, 383, 385, 386, 387, 388 .

Introduction

This document corrects ISO 10303-105:1996, Product data representation and exchange - Part 105: Application resource: Kinematics. The corrected document supersedes ISO 10303-105: 1996.

The purpose of the modifications to the text of ISO 10303-105: 1996 is to correct errors in the EXPRESS definitions likely to cause compilation problems, to include Formal propositions and Informal propositions to support the EXPRESS corrections, to clarify the text for proper usage of the EXPRESS, to replace the annex for the computer-interpretable EXPRESS with a URL reference, and to replace the object identifier for the document and the modified schema.

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Modifications to the text of ISO 10303-105: 1996

Clause 5.4.4, p. 16
The informal proposition ground_definition in 5.4.4 incorrectly stated an informal proposition. Remove the ground_definition informal proposition in 5.4.4 and replace with the following:

Informal propositions:
ground_definition: The **kinematic_ground_representation** shall be associated to **property\property_definition_representation.definition\-kinematic_property_defininition.ground_definition**.

Clause 5.4.12, p. 21
The EXPRESS specification contained logical errors in kinematic_link_representation. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY kinematic_link_representation
  SUBTYPE OF (representation);
  SELF\representation.context_of_items :
        geometric_representation_context;
DERIVE
  link_frame                  :  geometric_representation_context
                              := SELF\representation.context_of_items\
                              geometric_representation_context;
INVERSE
  link_representation_relation :
        kinematic_link_representation_relation FOR geometric_aspects;
WHERE
  WR1: SIZEOF (QUERY (item <* SELF\representation.items |
               NOT (('KINEMATIC_STRUCTURE_SCHEMA.RIGID_PLACEMENT' IN
                      TYPEOF (item))
                    OR
 ('GEOMETRY_SCHEMA.CARTESIAN_TRANSFORMATION_OPERATOR_3D' IN
                      TYPEOF (item))) )) = 0;
END_ENTITY;
(*
```

Clause 5.4.15, p.24
The definition of the entity kinematic_frame_based_transformation in 5.4.15 does not provide adequate definition for usage. The subtype shall be changed and additional formal and informal propositions shall be added. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY kinematic_frame_based_transformation
  SUBTYPE OF (geometric_representation_item,
     functionally_defined_transformation);
  transformator : rigid_placement;
WHERE
  WR1: SELF\geometric_representation_item.dim=3;
END_ENTITY;
(*
```

Add the following Formal proposition and Informal proposition after the Attribute definitions:

Formal propositions:
WR1: The dim shall equal 3.

Informal propositions:
An instance of **kinematic_frame_based_transformation** is equivalent to an instance of **cartesian_transformation_operator_3d** without scaling and mirroring, which is defined in ISO 10303-42, 4.4.17.

If **kinematic_frame_based_transformation.transformer_frame** refers to an instance of **axis2_placement_3d**, the equivalent **cartesian_transformation_operator_3d** can be derived as follows:

> The attributes local_origin and u of the **cartesian_transformation_operator_3d** should be set equal respectively to the attributes location and p of the **axis2_placement_3d**. The attribute scale of the **cartesian_transformation_operator_3d** should be set equal to 1.0.

If **kinematic_frame_based_transformation.transformer_frame** refers to an instance of **su_parameters**, the equivalent **axis2_placement_3d** can be calculated by applying the equations given in 5.4.17 **su_parameters**.

Clause 5.4.17, p.25
The definition of the entity su_parameters in 5.4.17 does not provide adequate definition for the requirements defined in this part of ISO 10303. The su_parameters is required to be a subtype of geometric_representation_item and have an additional local rule. Remove the EXPRESS definition and replace with the following:

EXPRESS specification:

```
*)
ENTITY su_parameters
  SUBTYPE OF (geometric_representation_item);
  a     : length_measure;
  alpha : plane_angle_measure;
  b     : length_measure;
  beta  : plane_angle_measure;
  c     : length_measure;
  gamma : plane_angle_measure;
WHERE
  WR1: SELF\geometric_representation_item.dim=3;
END_ENTITY;
(*
```

Clause 5.4.73, p.82
The EXPRESS in WR1 and WR2 of the ENTITY kinematic_loop contained logical errors in the body of the function. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY kinematic_loop;
  network : kinematic_network_structure;
WHERE
 WR1 : SIZEOF(USEDIN(SELF,
```

```
   'KINEMATIC_STRUCTURE_SCHEMA.JOINT_LOGICAL_RELATIONSHIP.LOOP')) > 0;
 WR2 : SIZEOF (QUERY( relation_1 <* USEDIN(SELF,
    'KINEMATIC_STRUCTURE_SCHEMA.JOINT_LOGICAL_RELATIONSHIP.LOOP') |
         SIZEOF (QUERY (relation_2 <*  (USEDIN(SELF,
         'KINEMATIC_STRUCTURE_SCHEMA.JOINT_LOGICAL_RELATIONSHIP.LOOP')
              - relation_1) |
              NOT(connected_in_simple_loop (relation_1, relation_2))
         )) > 0
       )) = 0;
END_ENTITY;
(*
```

Clause 5.5.3, p.87

The EXPRESS of the FUNCTION suitably_based_mechanism contained logical errors in the body of the EXPRESS function. Remove the EXPRESS specification and replace with the following:

<u>EXPRESS specification</u>:

```
*)
FUNCTION suitably_based_mechanism (mbp  : mechanism_base_placement;
                                   mech : mechanism) : BOOLEAN;
  LOCAL
    kprop  : kinematic_property_definition;
    kgrep  : kinematic_ground_representation;
    klrep  : kinematic_link_representation;
    klnk   : kinematic_link;
    kjnts  : BAG OF kinematic_joint;
    nmechs : BAG OF mechanism;
    nmbps  : BAG OF mechanism_base_placement;
  END_LOCAL;

  kprop := mech.containing_property;

  IF ('KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_GROUND_REPRESENTATION' IN
      TYPEOF (mbp\representation_relationship.rep_1)) THEN
      kgrep := mbp\representation_relationship.rep_1\
                kinematic_ground_representation;

    IF (kgrep.property\property_definition_representation.definition
        :=: kprop) THEN
      RETURN (TRUE);
    ELSE
      RETURN (FALSE);
    END_IF;
  ELSE
    klrep := mbp\representation_relationship.rep_1\
                kinematic_link_representation;
    klnk   := klrep.link_representation_relation.topological_aspects;
    kjnts  := USEDIN (klnk,
            'KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_JOINT.FIRST_LINK') +
              USEDIN (klnk,
            'KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_JOINT.SECOND_LINK');
    nmechs := USEDIN (kjnts[1].structure,
         'KINEMATIC_STRUCTURE_SCHEMA.MECHANISM.STRUCTURE_DEFINITION');

    IF (nmechs[1] :=: mech) THEN
      RETURN (FALSE);
    ELSE
```

```
      IF (nmechs[1].containing_property :<>: kprop) THEN
        RETURN (FALSE);
      ELSE
        nmbps := USEDIN (nmechs[1], 'KINEMATIC_STRUCTURE_SCHEMA.'+
                         'MECHANISM_BASE_PLACEMENT.BASE_OF_MECHANISM');

        IF (SIZEOF (nmbps) = 0) THEN
          RETURN (FALSE);
        ELSE
          RETURN (suitably_based_mechanism (nmbps[1], mech));
        END_IF;
      END_IF;
    END_IF;
  END_IF;
END_FUNCTION;
(*
```

Clause 5.5.6, p.90

The EXPRESS in the FUNCTION frame_associated_to_background contained logical errors in the body of the function. The initialization of the variable rep_bag was incorrect. The references in the USEDIN were in correct. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
FUNCTION frame_associated_to_background
  (frame      : rigid_placement;
   background : kinematic_frame_background) : BOOLEAN;
  LOCAL
    rep_bag : BAG OF kinematic_frame_background_representation;
    trf_bag : BAG OF kinematic_frame_based_transformation;
    trm_bag : BAG OF kinematic_frame_based_transformation;
    ass_bag : BAG OF
              kinematic_frame_background_representation_association;
    rep     : kinematic_frame_background_representation;
    ass     : kinematic_frame_background_representation_association;
  END_LOCAL;

  rep_bag := USEDIN (background\representation_item,
                     'KINEMATIC_STRUCTURE_SCHEMA.' +
                     'REPRESENTATION.ITEMS');

  IF SIZEOF (rep_bag) = 0 THEN
    RETURN (FALSE);
  END_IF;

  trf_bag := USEDIN (frame,
                     'KINEMATIC_STRUCTURE_SCHEMA.' +
                     'KINEMATIC_FRAME_BASED_TRANSFORMATION.' +
                     'TRANSFORMATOR');

  IF SIZEOF (trf_bag) = 0 THEN
    RETURN (FALSE);
  END_IF;

  REPEAT i := 1 TO HIINDEX (rep_bag);
    rep := rep_bag[i];
```

```
    ass_bag := USEDIN (rep\representation,
                       'KINEMATIC_STRUCTURE_SCHEMA.' +
                       'REPRESENTATION_RELATIONSHIP.REP_2');

    IF SIZEOF (ass_bag) > 0 THEN
      REPEAT j:= 1 TO HIINDEX (ass_bag);
        ass := ass_bag[j];

        trm_bag := QUERY (trm <* trf_bag |
          (trm\functionally_defined_transformation :=:
           ass\representation_relationship_with_transformation.
           transformation_operator));

        IF SIZEOF (trm_bag) > 0 THEN
          RETURN (TRUE);
        END_IF;

      END_REPEAT;
    END_IF;
  END_REPEAT;

  RETURN (FALSE);

END_FUNCTION;
(*
```

Clause 5.5.11, p.101

The EXPRESS in the FUNCTION connected_in_simple_loop contained logical errors in the body of the function. The ELSE clause was incorrect and the role names in the USEDIN statements have to be written in uppercase. Remove the EXPRESS specification and replace with the following:

<u>EXPRESS specification</u>:

```
*)
FUNCTION connected_in_simple_loop
   (relation_1 : joint_logical_relationship;
    relation_2 : joint_logical_relationship) : BOOLEAN;
  LOCAL
    next_jlr_in_loop_set : SET [1:?] OF joint_logical_relationship;
  END_LOCAL;

  IF ((relation_1.loop:<>: relation_2.loop) OR
       (relation_1 :=: relation_2)) THEN
         RETURN (FALSE);
  ELSE
    IF (relation_1.next_joint_logical_structure :=:
        relation_2.previous_joint_logical_structure) THEN
       RETURN (TRUE);
    ELSE
      next_jlr_in_loop_set :=
          QUERY (relation <*
           USEDIN (relation_1.next_joint_logical_structure,
           'KINEMATIC_STRUCTURE_SCHEMA.JOINT_LOGICAL_RELATIONSHIP.' +
           'PREVIOUS_JOINT_LOGICAL_STRUCTURE')
            | relation.loop :=: relation_1.loop);
      IF (SIZEOF(next_jlr_in_loop_set) <> 1) THEN
         RETURN (FALSE);
      ELSE
```

```
         RETURN (connected_in_simple_loop(next_jlr_in_loop_set [1],
                 relation_2));
      END_IF;
    END_IF;
  END_IF;
END_FUNCTION;
(*
```

Clause 7.4.3,p. 115
The EXPRESS in the ENTITY founded_kinematic_path contained logical errors in the DERIVE for founding. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY founded_kinematic_path
  SUBTYPE OF (representation);
  SELF\representation.items : SET [1 : ?] OF kinematic_path;
  SELF\representation.context_of_items :
       geometric_representation_context;
DERIVE
  paths : SET [1 : ?] OF kinematic_path := SELF\representation.items;
  founding : geometric_representation_context
           := SELF\representation.context_of_items\
              geometric_representation_context;
END_ENTITY;
(*
```

Clause 7.4.4, p.116
The EXPRESS in the ENTITY motion_link_relationship contained logical errors in the DERIVE for motion and frame_link. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY motion_link_relationship
  SUPERTYPE OF (ONEOF (prescribed_path, resulting_path))
  SUBTYPE OF (representation_relationship);
  SELF\representation_relationship.rep_1 : founded_kinematic_path;
  SELF\representation_relationship.rep_2 :
       kinematic_link_representation;
  related_frame                          : rigid_placement;
DERIVE
  motion     : founded_kinematic_path
             := SELF\representation_relationship.rep_1\
                founded_kinematic_path;
  frame_link : kinematic_link_representation
             := SELF\representation_relationship.rep_2\
                kinematic_link_representation;
WHERE
  WR1: related_frame IN frame_link\representation.items;
END_ENTITY;
(*
```

Clause 7.4.8, p.118
The EXPRESS in the ENTITY kinematic_analysis_result contained logical errors in the EXPRESS for WR1. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY kinematic_analysis_result;
  analysed_mechanism          : mechanism;
  contained_kinematic_results : SET [1 : ?] OF kinematic_result;
WHERE
WR1: (SIZEOF (QUERY (result <* contained_kinematic_results |
       'KINEMATIC_ANALYSIS_CONTROL_AND_RESULT_SCHEMA.RESULTING_PATH'
       IN TYPEOF (result)))
       > 0)
     XOR
     (SIZEOF (QUERY (result <* contained_kinematic_results |
       (('KINEMATIC_ANALYSIS_CONTROL_AND_RESULT_SCHEMA.'+
         'INTERPOLATED_CONFIGURATION_SEQUENCE' IN TYPE OF (result))
              AND
       (SIZEOF (QUERY (sequence <* result\
                interpolated_configuration_sequence.interpolation |
                (sequence.interpolation <> undefined ))) > 0)))) = 0);
END_ENTITY;
```

Annex B.1, p. 123
With the changes identified in this Technical Corrigendum, the object identifier for this part of ISO 10303 has changed. Remove the object identifier for the document and replace with the following:

{ iso standard 10303 part (105) version (2) }

Annex B.2.1, p. 123
With the changes identified in this Technical Corrigendum, the object identifier for the kinematic_structure_schema has changed. Remove the object identifier for kinematic_structure_schema and replace with the following:

{ iso standard 10303 part (105) version (2) object (1) kinematic-structure-schema (1) }

Annex B.2.3, p. 123
With the changes identified in this Technical Corrigendum, the object identifier for the kinematic_analysis_control_and_result_schema has changed. Remove the object identifier for kinematic_analysis_control_and_result_schema and replace with the following:

{ iso standard 10303 part (105) version (2) object (1)
kinematic-analysis-control-and-result-schema (3) }

Annex C, p. 124
With the changes identified in this Technical Corrigendum, the EXPRESS contained in digital form is incorrect. Replace the contents of the annex with the following:

This annex provides a listing of the EXPRESS entity names and corresponding short names as specified in this part of ISO 10303. It also provides a listing of the complete EXPRESS schema specified in this part of ISO 10303 without comments or other explanatory text. This annex is available in computer-interpretable form and can be found at the following URLs:

Short names: http://www.mel.nist.gov/div826/subject/apde/snr/
EXPRESS: http://www.mel.nist.gov/step/parts/part105/is/tc1/

If there is difficulty accessing these sites contact ISO Central Secretariat or contact the ISO TC 184/SC4 Secretariat directly at: sc4sec@cme.nist.gov.

NOTE - The information provided in computer-interpretable form at the above URLs is informative. The information that is contained in the body of this part of ISO 10303 is normative.

Annex D, p. 127, 128

With the changes identified in this Technical Corrigendum, Figure D.2 and D.3 is incorrect. Remove Figure D.2 and D.3 and replace with the following pages:

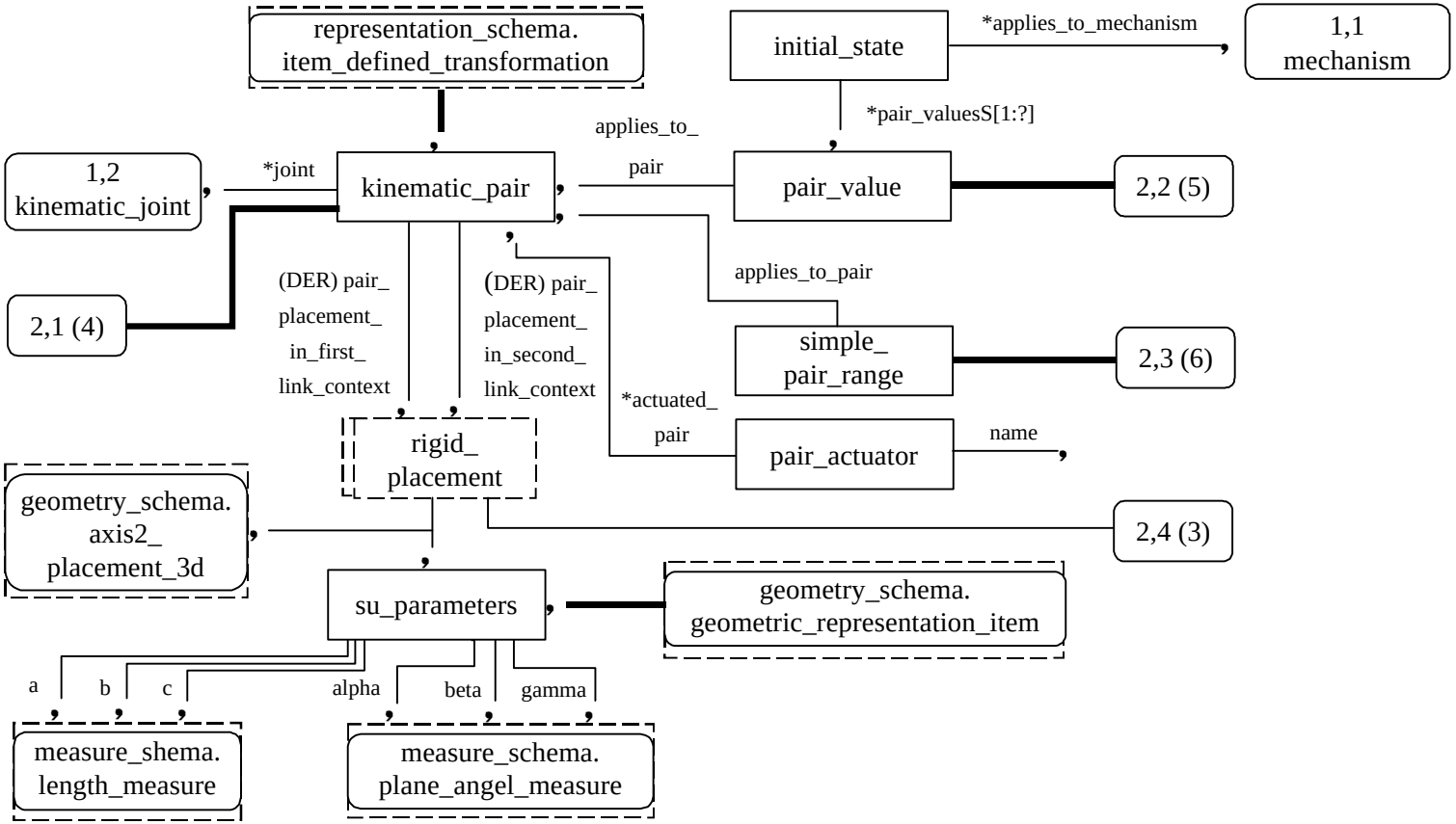

Figure D.2 - Graphical notation of the major aspects of the kinematic_structure_schema.

(See also figures D.1 and D.3 to D.7)

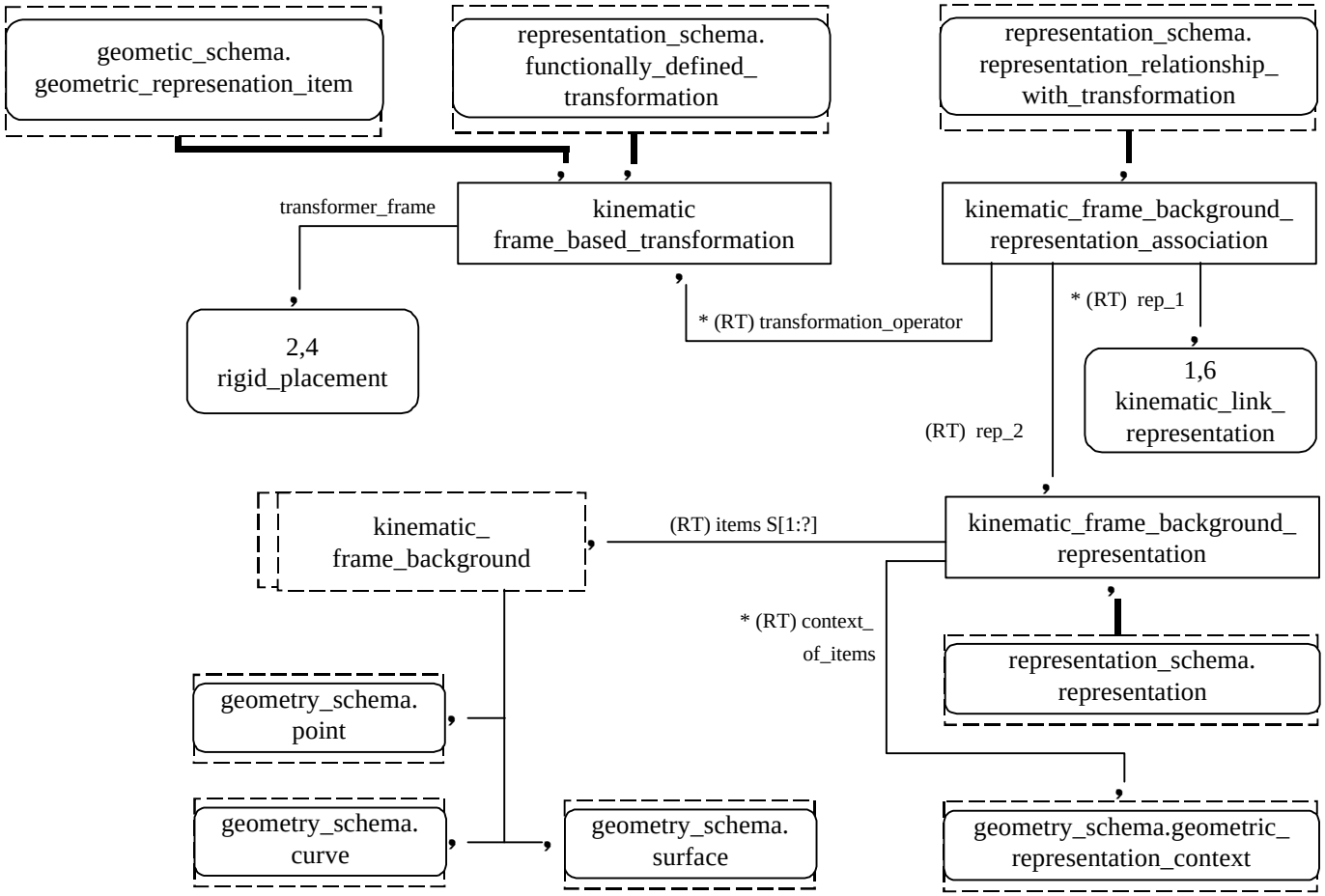

Figure D.3 - Graphical notation of the major aspects of the kinematic_structure_schema.

(See also figures D.1, D.2 and D.4 to D.7)

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