The Virtual Assembly Model of Alliance Coupling Parts

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Abstract:
Based on the technique of Pro/E parameterized modeling, the whole process of modeling and simulation of assembly has been carried out, which takes the Alliance coupling as application object. Thus, we can verify the correctness of various parts of the coupler’s model and its assembly.

Keywords: Alliance coupler; Virtual assembly; Model checking; Motion simulation

Introduction
Alliance coupler exclusively in railway vehicle in the United States. In this paper, by analyzing the coupling working status, the position changes of the key parts in the work, the working process of the motion simulation of Alliance coupling, use of the "components" module that provided by Pro/E to assembly of the implementation model. In Pro/E, the model according to certain constraints or connection assembly, assembly into a whole and can meet the design function.

The placement of components
There are three coupling parts is not easy to assembly, Hook tongue, coupler knuckle thrower and lower catch. Because the space is narrow, permissibility little scope can be adjusted. There are special assembly relationship, under the coupler knuckle thrower and lower catch in the process of movement. In the process of assembly, they need to cooperate with each other, need through trial and error, concluded that the assembly in parts, the cavity path and working position. [1]

Through the component placement control board to realize the parts assembly. Click the menu [file] - > [new] command, in the open dialog, select "components", click on the [yes] button, enter the "components" module working environment. In the component module work environment, click on the "open" dialog, select to assembly parts, click "open" button, component placement control board is shown in figure 1.

Assembly constraint type
Parts of the assembly process is actually a constraint limit process, According to the different parts model and the design needs, select the appropriate type of assembly constraint to locate parts model.

Common to complete a completely positioning of the parts, need to meet several
constraint conditions at the same time, such as Alliance coupler used in the process of assembly of several constraint type in Pro/E. Specific content as follows:

Alignment: Make the two parts specified plane, datum, the datum axis, points or edge can overlap or collinear, the datum axis, or collinear points or edge overlap. Coupler knuckles and coupler lock joint surface "alignment" approach and the offset value is zero on both sides cooperate situation as shown in figure 2. For "alignment" procedures, request with two parts must choose the same geometric features, such as plane to plane, surface of revolution to surface of revolution, etc. "Alignment" offset value can be positive also negative. If enter a negative value, the said offset direction contrary to the direction of the arrow in the model.

Insert: "insert" constraints make the rotation of the two parts specified surface have the same rotation axis, the rotating surface model is cylindrical, frustum of a cone, ball, etc. There is an example of "insert" the way of constraints for the coupler knuckle thrower and lower catch as shown in figure 3. First, make the axis of the positioning of the models; Secondly, select "insert" constraints; Finally, in the inner surface features of the selection of lock pin, select lock of the surface of the cylindrical bar of iron, can complete assembly "insert" constraints. [2]
"Insert" constraint is to determine the initial position of coupler knuckle thrower and lower catch. The reality is that under the locking position of knuckle thrower sitting above lock inner cavity. In order to finally determine the position of the coupler knuckle thrower and lower catch, still need to use the other constraint at the same time, Tangent: two assembly parts, each assigned a surface or plane, another for curved surface, make them tangent. Online: specified point on a component, in the other parts are specified on a line, make that point on the sidelines. The points on the surface: specify a point on parts, in the other parts are specified on a plane, then the specified surface and point of contact.

**Assembly connection type**

In Pro/E, there is a way of assembly parts - the connection assembly. Connection assembly can use Pro/Mechanism module directly actuator motion analysis and simulation, it USES the constraints set by the previous section conditions to define parts of motion and the way of degrees of freedom. The control panel as shown in figure 4.

Use the lower catch and lower catch lever connections for example, creating a connection assembly. Lower catch lever under the function of the lock force and rotates, its tail in the making of planar motion, the actual movement for two kinds of combined motion of the movement. According to the principle of its movement, in the heart of the agency lower catch and lower catch lever connection is defined as the slot connection.
Slot connection is a point between the two main body - curve connection. A point on the follower, and always movement on the active parts of a curve. Slot connection can only make two main body in accordance with the requirements of the specified movement, do not check whether the interference between the two subjects, points and curves can even be part entity outside of the reference point and benchmark curve, of course, can also be within the entity. Curve can be any of a group of adjacent curve (requirements are linked together, don't have to be tangent), can be a reference curve, can also be a entity/surface edge, can be open, also can be closed. Reality is lower catch lever groove along the lower catch movement, so draw groove curve implied in lower catch. Draw a dot on the lower catch lever. This can be any a reference point or point, but is only part of the point, in the component cannot be used for slot connection. As shown in figure 5.

![Diagram](image)

Groove curve  Rough spot
Figure 5. coupling parts assembly connection type.

In the movement, the point of the follower is always on a given curve of the active parts. If the curve is an open curve, the curve of the first end point as slot default endpoint. If it is a closed curve, the default it endless. If you don't want movement range is the whole curve, but only one paragraph, you need to customize tank endpoint. For open curve, only need to specify the new endpoint. For a closed curve, specify two new endpoint, the system automatically selected by two endpoints segmentation of the two curves in the paragraph for running interval, if not need, choose the "reverse", to select another section. Slot connection can also be defined "recovery coefficient" and "friction".

Lock, the lower catch rotation driven by external forces lower catch lever, here by the motor that setting at the lower catch lever to simulate its state.

And then set the initial conditions. Kinematics analysis was carried out on initial condition after all set up and save the results of the analysis. Choose "replay" command can broadcast the results of the analysis.

**Summary**

By analyzing the inner cavity of the parts in the Assembly function and the constraint relations, the paper presents a method of virtual Assembly based on Pro/E. Using Pro/comprehensive analysis, detection and correction Mechanism module Alliance coupler assembly model, to conform to the original model of reverse design, accurate reduction design parameters as far as possible.
References
