FORD/EFHD
WIPEVIEW v.1.0

Wiper System Mechanism
Kinematic & Dynamic Modeler

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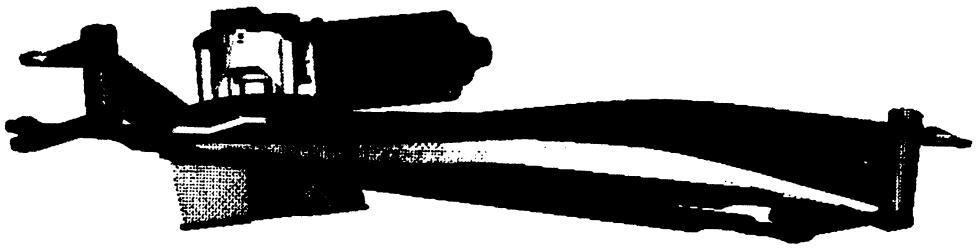
ABSTRACT

WIPEVIEW is a Wiper System Modeling tool integrated into the ADAMS/VIEW Mechanical Simulation Software. WIPEVIEW uses the kernel of the EFHD/FORD Wiper Kinematic Tool that performs rigid body mechanism synthesis and analysis. The kernel of the EFHD/FORD Wiper Kinematic Tool is linked into the ADAMS/VIEW code. Through custom menus the synergy between the EFHD/FORD Wiper Kinematic Tool and ADAMS Mechanism Simulation is realized. In addition, WIPEVIEW offers the kineto-static and dynamic modeling capabilities inherent to ADAMS. Development of WIPEVIEW was centered on strong functionality with high usability. To accomplish this task, a model construction method using high level primitives, was implemented.

This method uses 3D four-bar linkages as the primary high level primitive. The user specifies the topological relationship between the 3D four-bar linkages, then describes the geometric properties of each 3D four-bar linkage individually. This simplifies the task of describing the mechanism in a format amenable to the computer. This construction technique also allows the engineer to repeatedly use advanced 3D four-bar linkage synthesis techniques without the burden of simultaneously designing the entire mechanism.



Wiper system mechanism with mounting module and motor

DISCUSSION

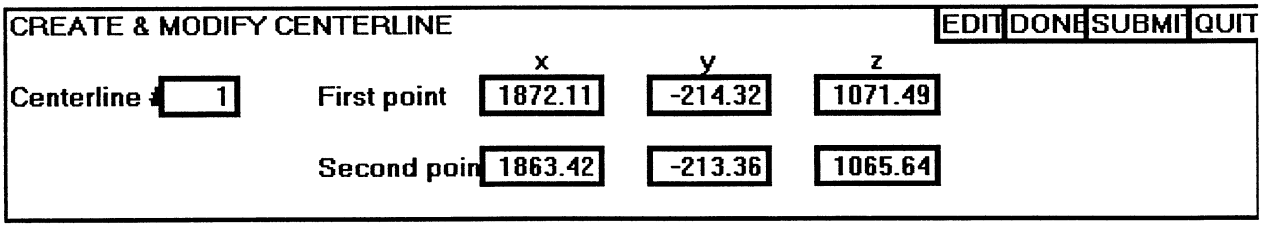
Introduction

To meet the continuously increasing demand for high quality products in short design cycles engineers must make better use of Computer-Aided Engineering tools. Engineers must not only continuously improve the scope of system simulations, engineers must perform these simulations in shorter time. WIPEVIEW harnesses the mechanism modeling of wiper systems and makes it quick and efficient to implement. This type of tool gives the engineer critical information to make design decisions without stripping the engineer of the ability to explore alternative designs.

An entire wiper system mechanism is constructed using two primitives. The centerline and the 3D four-bar linkage are the primary mechanism primitives used. The centerlines are ground reference primitives. A 3D four-bar linkage is a primitive used to describe portions of a more complex mechanism. Together these two primitives can construct nearly all wiper system mechanisms in vehicles on the road today.

Perhaps, the most innovative part of WIPEVIEW is the 3D four-bar linkage primitive. This primitive is treated much like existing primitives in ADAMS/VIEW. The user creates a 3D four-bar linkage by first describing its topological and geometric relationship to other primitives. The user then enters the geometric and functional properties of the 3D four-bar linkage. The geometric and functional properties are processed using analysis and synthesis construction techniques to complete the linkage description.

There are three construction techniques available for development of a 3D four-bar linkage in WIPEVIEW. The Analysis option is a traditional development technique that uses the geometric description of the 3D four-bar linkage as inputs. The remaining two construction techniques are syntheses, which profoundly increases the engineer's ability to achieve design objectives. The two Synthesis options use the functional requirements as inputs and generate the geometric parameters that satisfy these functional requirements.



Centerlines

A centerline is a primitive used in the description of a wiper system. Centerlines are used to represent pivot shafts that are mounted to the vehicle. Centerlines locate the wiper

system relative to the rest of the vehicle. They will be used later to reference the attachment of the wiper mechanism to the vehicle.

A centerline is described using two points. These points are categorized as 1st and 2nd point on a centerline. The 1st point locates the centerline vector in space. The 2nd point is used to define the direction of the centerline vector in space.

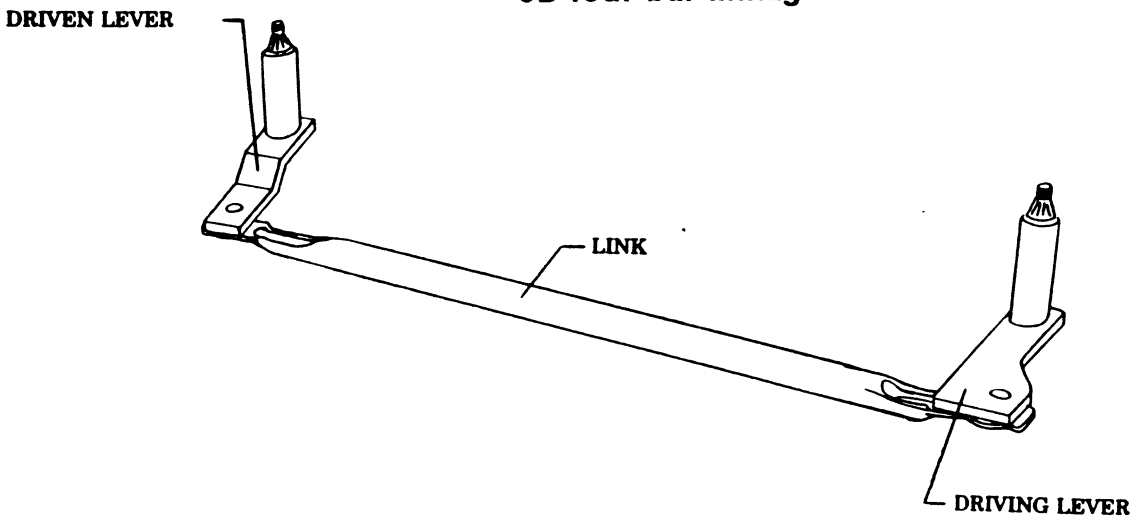
3D Four-Bar Linkages

CREATE & MODIFY FOURBAR				EDIT	DONE	SUBMIT	QUIT
Driven Centerline #	1	Driving Centerline #	0				
Driven Lever Radius	86.25	Driving Lever Radius	53.33	Type of Assembly			
Balance Angle (Deg)	-12	Balance Angle (Deg)	0	Driven Synthesis			
Toggle	0	Toggle	0				
Link Length	423.12	Lever/Plate Angle (De	13.71				
Run Arc/Wipe Angle (Deg)	88.22	Distance Along CL	23				
Depressed Park Angle (De	8.14	Depressed Park Throv	10				

A 3D four-bar linkage is a primitive used in the description of a wiper system. 3D four-bar linkages are used as primitives to construct more complex mechanisms. A dialogue box, which queries geometric and functional parameters, is used to generate the 3D four-bar linkages.

A 3D four-bar linkage is described using length of links and levers, although these lengths can be generated by the computer using available synthesis procedures. The synthesis procedures can be selected in a dialogue box, along with functional requirements. The synthesis procedure will then generate lengths of links and levers to satisfy the desired functional requirements.

3D four-bar linkage



Construction Method

Construction of a mechanism using centerlines and 3D four-bar linkages has an intended flow. The construction process consists of two main steps. First, the user specifies the centerlines relative to the ground reference frame. Second, the user specifies the 3D four-bar linkages.

The centerlines are specified using two points located relative to the ground coordinate frame. The first point locates the origin of the centerline and the second point identifies the centerline negative z-direction. A ground marker is generated for each centerline using the first and second point. Directions of the remaining axes of each ground marker are transparent to the user since they are not directly referenced.

Construction of a four-bar takes place in a single dialogue box. A four-bar consists of a driving lever, a driven lever and a link. The four-bar is located in space by specifying which centerlines the driven lever and driving lever are attached. A centerline number is queried for each the driving lever and the driven lever. Geometric inputs are queried to describe parameters like the lengths of levers and links. Also, functional inputs are queried such as the Wipe Angle, which is the angle a driven lever moves through in a cycle.

Finally, when the desired parameters are input an assembly type is specified. The type of assembly process indicates which of the inputs are user defined and which of the inputs are computer generated. An analysis assembly will use the geometric parameters as inputs and generate the linkage. A synthesis assembly will use the functional parameters and some geometric parameters as inputs and generate the remaining geometric parameters to satisfy the functional parameters.

The computer generated parameters, calculated in the assembly processes, are computed by the FORD/EFHD proprietary code. The FORD/EFHD code is linked into ADAMS/VIEW to make a custom ADAMS/VIEW executable file. During operation of the custom ADAMS/VIEW, the FORD/EFHD code updates the four-bar data structure and generates the added information needed for ADAMS/VIEW to build the mechanism.

Conclusion

Development of WIPEVIEW was centered on strong functionality with high usability. The key features that support these objectives are high level primitives and synthesis assembly processes. The ability to build each four-bar of a more complex mechanism individually provides a profound ability to rapidly iterate to meet design objectives. ADAMS/VIEW has great flexibility to develop task specific applications. Custom menus and linking user codeare critical features that make this tool possible.