

## SAMSRAIL

The SAMS2000 code is a general purpose multibody computer program that can be used for the dynamic simulation of constrained mechanical and structural systems that consist of interconnected rigid and deformable bodies; each of which may undergo a finite rotation. The program has the capabilities of performing different types of analyses.

SAMSRAIL is the rail module in SAMS2000 that can be used to simulate wheel/rail interaction. This module of the SAMS2000 program allows the user to define contact models between rigid bodies. The user can define the number of contacts, the associated creepage force model, and the number of printing information segments. This contact module allows predicting the point of contact between rigid bodies on line. There are several methods for wheel/rail contact analysis that are implemented in the SAMS2000 program. Among these methods are

1. The Embedded Contact Constraint Formulation (ECCF)
2. The Augmented Contact Constraint Formulation (ACCF)
3. The Elastic Contact Formulation I (ECF-N)
4. The Elastic Contact Formulation II (ECF-A)

The ECCF and ACCF are in principle the same except for the solution procedure used. In ECCF, the surface parameters are expressed in terms of the wheel set coordinates, and therefore, the surface parameters can not be used as degrees of freedom. In the ACCF, the contact constraint equations are augmented to the dynamic equations and the surface parameters are treated as non-generalized coordinates. In this case, the surface parameters can be selected by the program as degrees of freedom. In the ECF-N, the contact between the wheel and the rail is described using a compliant force element instead of kinematic constraints. Nodal search is used to determine the location of the contact point. In the ECF-A, the contact points are determined by solving algebraic equations instead of using nodal search. This can lead in some applications to smoother solutions.

The details of the formulations used in these methods can be found in the following papers:

1. Shabana, A.A., and Sany, J.R., "An Augmented Formulation for Mechanical Systems with Non-Generalized Coordinates: Application to Rigid Body Contact problems," *Nonlinear Dynamics*, Vol. 24, No. 2, 2001, pp. 183-204.
2. Shabana, A.A., Berzeri, M., and Sany, J.R., "Numerical Procedure for the Simulation of Wheel/Rail Contact Dynamics," *ASME Journal of Dynamic Systems, Measurement, and Control*, Vol. 123, No. 2, 2001, pp.168-178.
3. Shabana, A.A., Zaazaa, K.E., Escalona, J.L., and Sany J.R., "Development of Elastic Force Model for Wheel/Rail Contact Problems," *Journal of Sound and Vibration*, Vol. 269, 2004, pp.295-325.
4. Shabana, A. A., Tobaa, M., Sugiyama, H., and Zaazaa, K E., "On the Computer Formulations of the Wheel/Rail Contact Problem," *Nonlinear Dynamics*, 40, 2005, pp 169-193.