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SIMULATION OF MECHANICAL VIBRATION HARVESTING PROCESS OF FOREST FRUIT CROPS

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Summary. *The key to mechanized harvest of forest and fruit crops is efficient and low-loss picking. The existing machinery is mainly vibrating picking machinery. In order to prevent the resonance phenomenon between the machine and the fruit tree from damaging the trunk during picking, it is necessary to use ANSYS and ADAMS software to conduct dynamic simulation of the picking process.*

Save the high-acid apple tree model constructed by Solidworks into Parasolid format and import it into ANSYS to generate the high-acid apple tree flexible model. The simulation model is shown in figure 1.

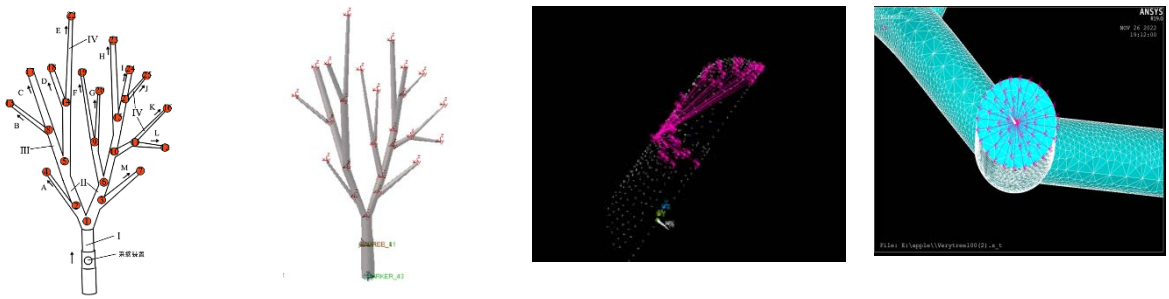

Figure 1 – Simulation model and node establishment

The base of the high acid apple tree trunk was defined as the fixed contact, and the exciting function was defined for the picking mechanism. The vibration energy of the high acid apple tree was transferred from the Ⅰ main trunk to the Ⅱ, Ⅲ and Ⅳ main trunk respectively. ADAMS software is used to set 25 Marker points at the vertex and fork of each branch, and there are 13 paths for energy transfer.

1. Import 3D model in Solidworks X-T file saved.

2. Create three types of units in Element Type: Unit 1: solid185 is the physical unit of the tree; Unit 2: MASS21 mass unit, this unit is only used to connect nodes (master nodes).

3. Meterial Props add material type: set elastic modulus, Poisson ratio, density three parameters.

4. Grid division: In the mash tool, select Smart Size to mesh the volume and set the precision to 2.

5. Create an external interface point: In Modeling-creat, add one key point on each side of the tree trunk at the height of the addition. In order to ensure that

all loads can affect the deformation mode in the ADAMS simulation, it is necessary to define all nodes to which the force or motion pair is to be applied as interface points.

6. Define Real constant properties for MASS21 mass unit in Real Constants: Set Real Constant Set No. To 2, and set Real Constants for 3-D Mass with Rotary Inertia to as small as possible. In this case, set it to 1e-10.

7. Select the MASS21 unit with set attribute values in the Meshing-Mesh Attributes-Default Attribs, and mesh the two connection points created in the Mesh Tool.

8. Establish a rigid area (Adams as a non-deformable area connected to a rigid body): The rigid areas are all nodes include connecting nodes and all nodes on the rigid and flexible contact surface; The connection points in Ansys are the two interface nodes created above, and the slave nodes are all nodes on the rigid and flexible contact surface.

9. Output mnf file: In Adams connection, select Solve and creat export file to Adams to complete the mnf file export. This mnf modal neutral file contains the mass, center of mass, moment of inertia, frequency and mode of the flexible body.

Adams creates a new database and imports the apple tree X-T file saved by Solidworks, and reads the mnf file saved by ANSYS above to replace the original rigid tree model. The connection between the bottom of the tree and the earth is defined as a fixed connection. The inertia force generated by the eccentric block in the working state of the fixture is simplified to the harmonic exciting force directly applied to the external node created in the mnf file: F = 2750*sin (150*time); marker points are established in each secondary branch to measure and analyze the motion of each point in the tree during vibration.

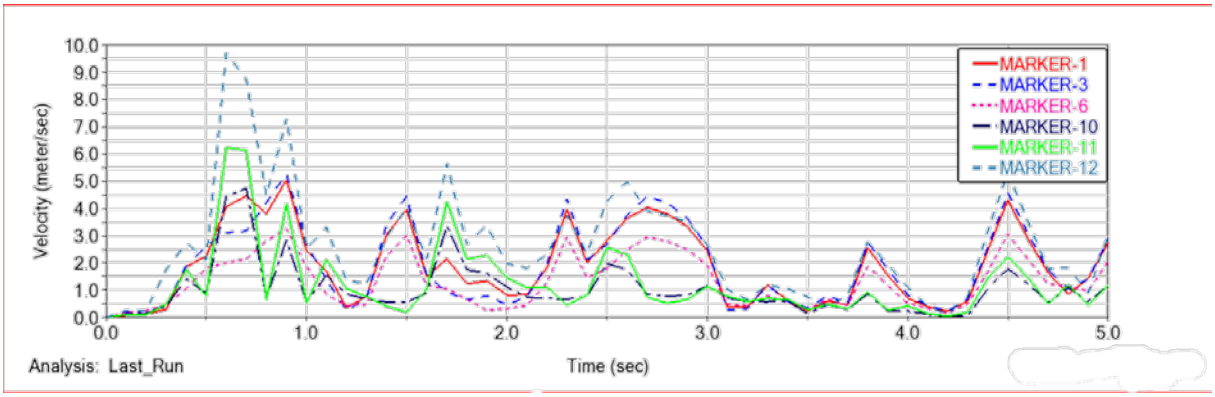

Figure 2 – The intensity of the shaking of a branch

Through the simulation results, the vibration intensity of each branch of the fruit tree can be obtained, which can provide data support for the optimal design of harvesting machinery.