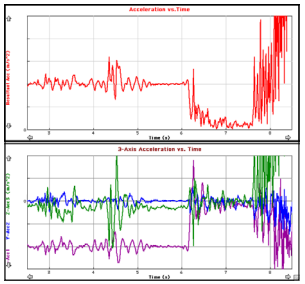
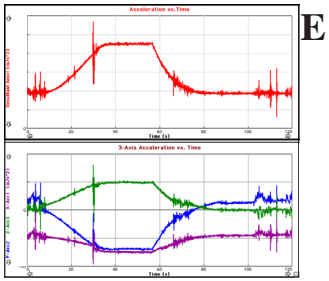
A



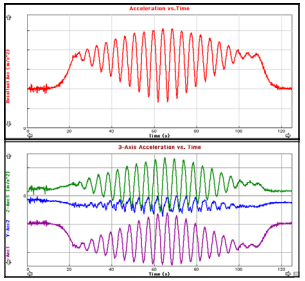
AMUSEMENT PARK PHYSICS
MATCH GAME

Match Acceleration Traces to Cedar Point Amusement Park Rides

E



B



Introduction

Rides at an amusement park may be differentiated by the pattern of accelerations to which a rider is subjected. This acceleration experience, coupled with height, speed, and the unknown, produce an experience unique from ride to ride.

Use your knowledge of accelerations and these ride descriptions to match the ride with the accelerations experienced on the ride. The 'feel' of each ride is different, but the acceleration pattern may look similar. Think and choose wisely!

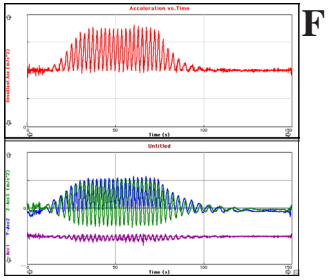
Linear acceleration is a straight line acceleration quite often experienced when a ride begins and ends. This may also be felt when a brake is applied during the course of a ride, such as on a roller coaster to control the maximum speed. Centripetal acceleration is due to circular motion and quite often causes a rider to be forced to the outside of the curve. This is found on circular rides but also can be found on roller coasters going around a curve or turn-around.

Earth's gravitational acceleration (1-g) is 9.8 m/s^2. The accelerations were measured with a reference frame fixed to a rider's body.

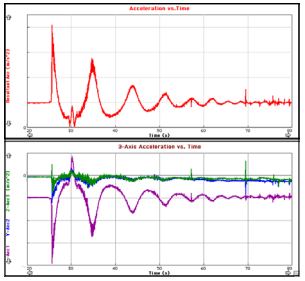
- The X-axis is along the rider's spine with positive being downward.
- The Y-axis is along the rider's left arm with positive being outward.
- The Z-axis completes a right-handed coordinate system and is perpendicular to the rider's chest with positive being forward.

The resultant acceleration is the vector (root-sum-square) of the three individual axes.

F



C



1 - CHAOS

Chaos is an unusual ride in that the rider experiences accelerations in random directions, magnitudes, and times. It is basically a circular ride with the riders initially facing outward and each two-seat car has a sideways axis of rotation allowing 360 degrees of rotation. . The ride is rotated with the riders going sideways and after spinning up, the ride s major axis is tilted.

2 - DEMON DROP

The Demon Drop is a free-fall ride where a carriage with four riders is taken vertically upward, moved horizontally about 3 meters, suspended for a few seconds and then dropped vertically with the acceleration of gravity. The free-fall motion is straight down until a smooth transition to horizontal motion is accomplished and brakes are applied.

3 - MAGNUM XL-200

The Magnum roller coaster is an out-and-back track design with a banked, dog-bone turn-around. It has a very tall first hill and tall second hill plus numerous shorter hills.

4 - POWER TOWER

The Power Tower is another free-fall ride with four independent carriages. Each carriage has twelve seats facing outward from the support tower. Two of the four carriages blast the riders upward with a momentary thrust which then releases the carriage for a moderate free-fall. This carries the carriage upward and upon descending, the carriage bounces several times against compressed air pistons. The other two carriages slowly raise the carriage, pause at the top for a few seconds, and then release the carriage in a moderate free-fall downward. The carriage also bounces several times against compressed air pistons after it is released.

On which carriage was the rider sitting for the data shown here?

5- ROTOR

The Rotor is a large rotating cylinder in which the riders stand with their backs to the wall. The cylinder is then rotated up to a constant speed. When it attains a certain rotational speed, the floor is lowered and the riders stay suspended on the textured wall by the centripetal force. While the rotation rate is reduced, the floor is returned to the riders' feet.

6- SCRAMBLER

This ride has a set of cars arranged in a circular fashion. Each set of cars rotate together around a vertical axis of rotation. Each such axis (along with the axes of the other sets of cars) is rotated around a central vertical axis. When the ride is at operational speed, an individual car performs a cycloid-type motion.

The Calypso is similar to the Scrambler, but the axes of rotation are tilted with respect to gravity.

7- WITCHES WHEEL

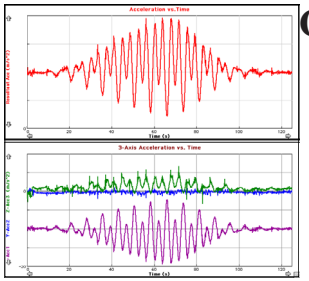
The Witches Wheel is a circular type ride with cars suspended below a rotational axis which allows each car to swing freely side-to-side. When the ride is rotated to a high rate of speed, the cars swing outward due to centripetal acceleration. The central axis of rotation is then tilted until it is nearly horizontal. Centripetal force is strong enough to keep the cars outward from their rotational axis, which puts each car (and its riders) upside down periodically.

8 - OCEAN MOTION

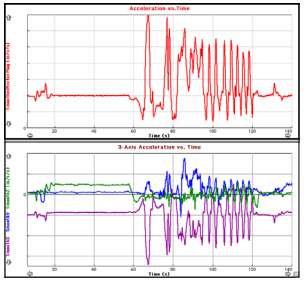
The Ocean Motion is a pendulum type of ride with a large boat holding about 50 riders is suspended below its horizontal axis. Motors push the boat back and forth until it is swinging about 90 degrees end-to-end.

For the data shown here, where was the rider sitting in the boat?

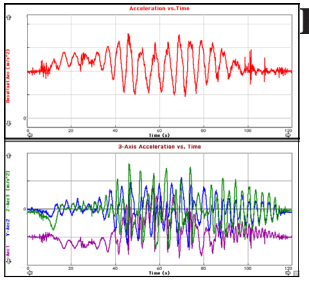
G



D



H



National Aeromautics and
Space Administration

John H. Glenn Research Center

R.D. 9/30/02