Project no. TIP5-CT-2006-031415

INNOTRACK

Integrated Project (IP)

Thematic Priority 6: Sustainable Development, Global Change and Ecosystems

D1.4.4 On-line knowledge repository

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Glossary

Abbreviation/acronym	Description
NMT	New Measurement Train
SMT	Southern Measurement Train
UGMS	Unmanned Geometry Measurement Systems
WILM	Wheel Impact Load Measurement

1. Executive Summary

The University of Birmingham hosts a bank of servers available to support industrial research and development projects. These are Windows based and are available to be configured to suit individual project requirements for Web applications, databases, etc. For the INNOTRACK project some of these servers have been configured to hold industrial railway data such as Wheel Impact Load Measurement (WILM), Unmanned Geometry Measurement System (UGMS), track recording car data, as well as data produced as outputs of tools such as Clementine.

The servers are provisioned to support small industrial 'experiments', such as data processing, data integration and data mining. However, they can be configured for additional large scale data storage if required.

To date in the INNOTRACK project, some of the data used has been stored on the servers, and simple data processing routines have been developed. In the final stages of SP1 it is planned that more comprehensive data processing and data mining routines will be developed.

The servers are being used predominantly by researchers at the University of Birmingham, but access can be granted to external clients.

It should be noted, that the main content of D1.4.4 is the presence of the servers and associated data itself, and not the content of this report.

2. Data Sources

The data currently stored on the servers includes:

Data Type	Measurement System	Data Provider
Measurement Train Data	New Measurement Train (see 2.1.1)	Network Rail, UK
	Southern Measurement Train (see 2.1.2)	Network Rail, UK
	Unattended Measurement Data	University of Birmingham, UK
Clementine		Network Rail, UK Corus, UK Deutsche Bahn, Germany
Wheel Impact Load Measurement	WheelChex	Network Rail, UK
	Azdek	České dráhy (CD), Czech Republic

2.1 Measurement Train Data

The main source of data collected thus far is from the Network Rail operated New Measurement Train (NMT) and Southern Measurement Train (SMT).

2.1.1 Network Rail New Measurement Train (NMT)

The NMT is owned and operated by Network Rail, Britain's infrastructure manager. The train is run over the entire rail network (excluding the Southern region) every two weeks.

Figure 1 - New measurement train (copyright Network Rail)

Data is collected relating to:

- Track geometry
  - Top (vertical left and right rail profiles)
  - Crosslevel
  - Cant
  - Gauge
  - Curvature
  - Cyclic top
  - Lateral alignment
- Rail
  - Profile
  - Wear
- Overhead catenary
  - Position
  - Wear
- High definition cameras
  - Track ahead
  - Wheel/rail interface
  - Individual clips and sleepers
  - Check the six foot
  - Observe vegetation
  - Signal sighting.
- Microphones to monitor ‘excessive bogie noise’
- Radio survey to check the state of the radio communications infrastructure

2.1.2 Southern measurement train (UFM160)

Figure 2 - Southern Measurement Train (Eurailscout UFM160)

The Southern Measurement Train cover the area directly south and south-east of London. The train runs at speeds of up to 100mph.

Data is collected relating to:

- Track geometry
  - Top
  - Alignment
  - Cant
  - Twist
  - Cyclic top
- Overhead wire
  - Position
  - Mast pole position
- Rail

    - Height
    - Head width
    - Cant
    - Type.
- Rail surface
    - Rail cracks
    - Rail joints
    - Burns
    - Wear on welded joints
    - Deformation by roller bearing balls
    - Short wave wear
    - Missing fasteners
- Video observation
    - Rail, track
    - Rail surroundings
    - Signal visibility
    - Vegetation check
    - Contact wire
- D-GPS Positioning

The train also includes an 'experimental' third rail position measurement system using video technology.

2.1.3 Clementine

One of the tasks of Work Package 1.2 (WP1.2) was to develop a method to divide a railway route into a series of segments, and to identify which of the segments were most important in terms of their contribution to track maintenance costs. The source data for the segmentation process was taken from track recording car output, but the large volume of data involved, meant manual analysis was not feasible. It was decided therefore, to use a data mining tool called 'Clementine', to identify the segments.

The first step in the data mining process was to carry out an audit of the data supplied by the infrastructure managers; in particular, the audit checked for consistency of units, and sought to remove null and outlying values. The next step involved analysis to segment the track based on radius of curvature; an important factor in determining the extent of track degradation. The output from the analysis was a schedule of curves, their locations and their radii, which was integrated with track condition and construction data to identify the critical segments.

Clementine provided the facility to automate a substantial part of the process described above. It has a flexible, modular framework, which allows the analyst to introduce filters to highlight and deal with data problems, such as null and outlying values. Modules can also be inserted to convert data from one set of units to another. It can integrate and analyse data streams, such as vehicle speed and horizontal acceleration, to come up with values for radius of curvature. And finally, it can produce reports on the results of the analysis.

2.1.4 Wheel Impact Load Measurement

Figure 3 - WheelChex Installation

'WheelChex' is a lineside (wayside) measurement system that monitors rolling stock as it passes. The system consists of loading (force) measurement components that are connected to a PC based logging system. The 'WheelChex' system is capable of rapid interpretation of complex information to provide data on the condition of individual wheels and axles. Since trains in the UK are not routinely tagged, the data from a 'WheelChex' system is uploaded to a central server each night where it is combined with other data and passed on to the appropriate TOC/maintainer. The maintainer uses this information to identify and rectify faulty wheelsets.

Wheelchex® was developed by AEA Technology Rail and first installed on UK infrastructure in 1998. Currently there are 26 installation across the country and a further 2 systems awaiting instalment.

The original need for the technology came from the Infrastructure owner, Network Rail:

"As Wheelchex was originally perceived to be a track "tool", it was assumed to be an aid to remove vehicles that failed to meet the Railway Group standard limits. However, as the System team recognised, the actual data "owner" should have been the train operator as early detection of deterioration was perceived to be a better use of the system."

The system uses a series of strain gauges attached to the rail with equipment positioned between sleepers and trackside. The device is sufficient in length to recorded rail stresses for the complete wheel circumference.

All recorded data is sent electronically to a central support centre where it is post-processed and presented using software developed in-house. The figure below shows a screen shot of Wheelchex data; quasi-static loads are marked by green lines, dynamic impact loads marked by red circles, and wheelsets plotted by distance. From the example plot the train can be identified as a freight train – it has a leading loco with 6 wheelsets and a number of wagons (16 displayed) with varying loads. Wheel defects (resulting in impact loads above 200kN) have been recorded for a left-hand wheel of the ninth and tenth wagons.

Faulty wheels are identified in real time and fault reports are sent immediately to notify the Infrastructure owner and the relevant RS operator of severe wheel faults causing dynamic impact loads over 350kN.

3. Accessing the Servers

The servers are managed by Richard Lewis and Rhys Davies at the University of Birmingham. Access can only be gained from machines that have had their IP address pre-registered with the server managers.

Once a machine's IP has been registered, access can be gained by typing:

ftp://147.188.146.56

into an internet browser. The dialog box shown in Figure 4 should then appear.

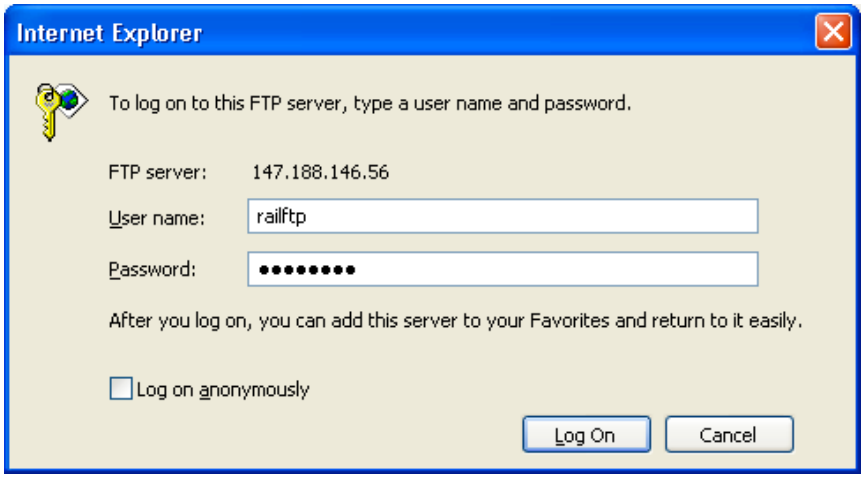

Figure 4 - Server login dialog box

In the dialog box shown in Figure 4 enter the username 'railftp' and the password 'srpjn541'. Access will then be given to the servers. The user must navigate to specific systems, and then sites. A window, as shown in Figure 5, will then be displayed where the data can be accessed.

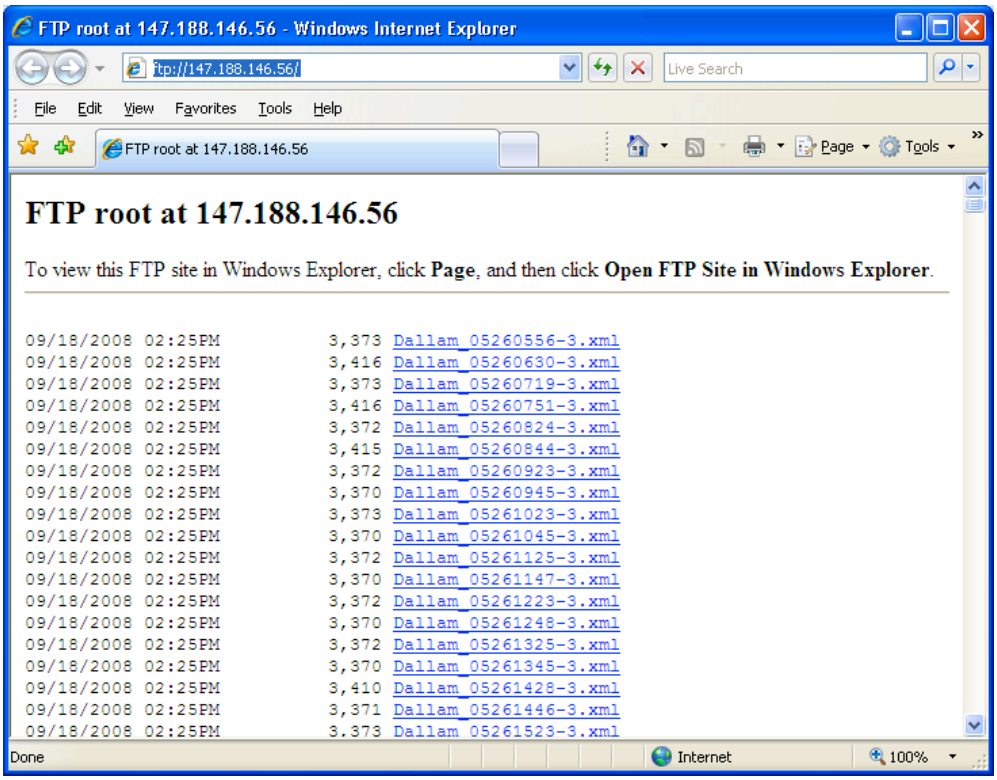

Figure 5 - Server data window

4. Conclusions

To date a knowledge repository has been set-up at the University of Birmingham. Data from a number of European systems including Wheel Impact Load Measurement (WILM), Unmanned Geometry Measurement System (UGMS), track recording car data, as well as data produced as outputs of tools such as Clementine has so far been uploaded. During the remainder of the project, further data will be uploaded to allow a centralised repository of the INNOTRACK project resources.

The servers are provisioned to support small industrial 'experiments', such as data processing, data integration and data mining. However, they can be configured for additional large scale data storage if required.

Further work will be performed during the remainder of the project to undertake further data mining on the data currently stored.