

**Tower Yarder Operation in Japan
and the
Performance Analysis by GPS-based system**

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Tower Yarders in JAPAN, again

- Low activity in timber production, many stands to be thinned
 - After 3.11, energy production by various means
 - Promotion and policy to double timber production
 - Tower yarder had introduced 20 years ago but did not succeed
 - Subjects,
 - Enlarge one production lot
 - En-balanced forest road networks
 - Adequate mechanization for operation.
-
- **GPS location**
 - **GPS data showed clearly the operation cycles**

Tower Yarder Operation in Japan 1



Young stands
thinning

Trailer Tower Yarder
-Mitsuyama Green Project

Tower Yarder Operation in Japan 2



Track Tower Yarder
-Sumitomo Forestry, NEDO JAPAN



Processor for tower yarder
operation

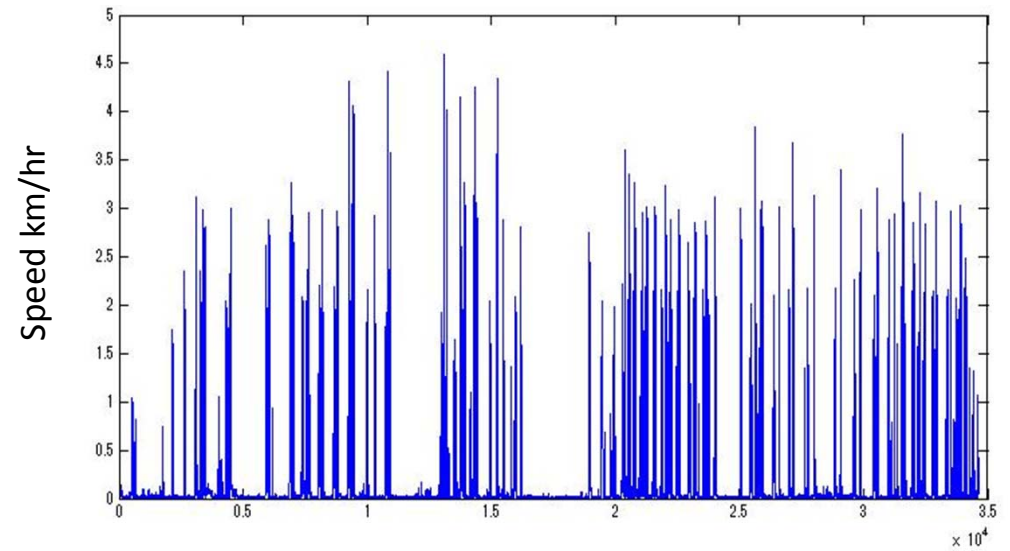
GPS Data Acquisition for Field Operation

- iterating run between tower mast and log choking neighbor points
- Loci of foremen and a processor operator were scattered around skyline and spots where did carriage line extension and haul.
- 1) Carriage movements





Figure 1. Location of tower yarder operation at clear cut for energy wood harvesting



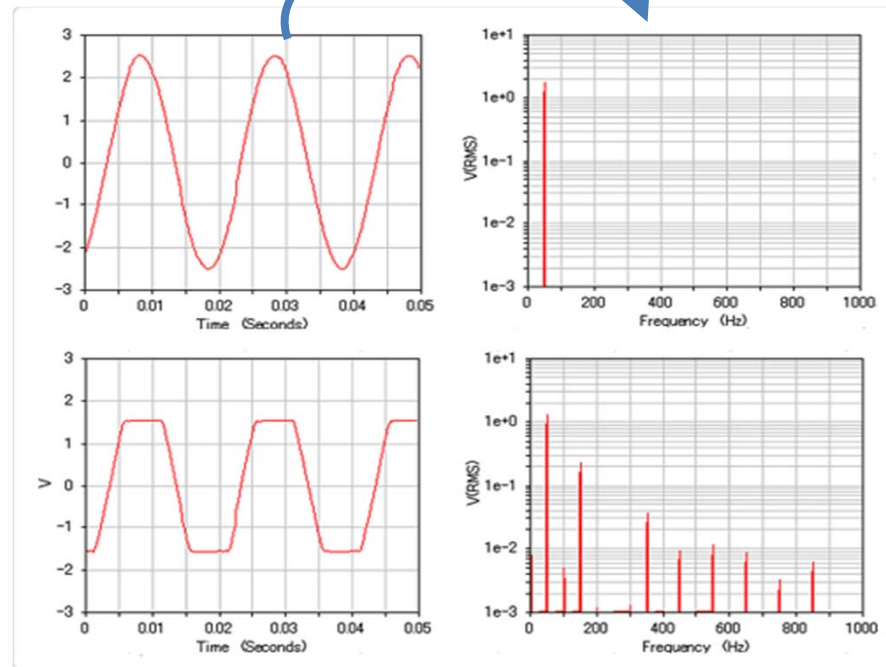
time: 07:35:10 - 17:13:05

Figure 2. Carriage speed in a day

FFT-Fast Fourier Transform

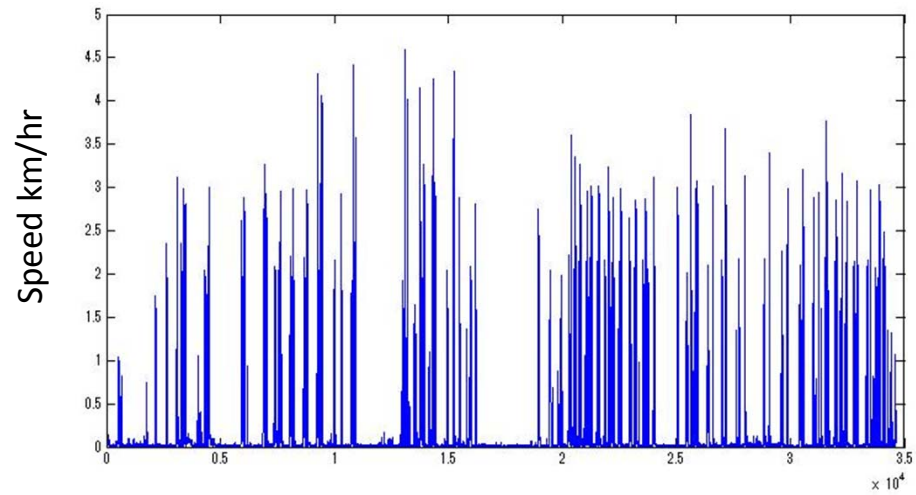
Simple wave signal

Single frequency



Imposed multi-frequency signal

Multi wave frequency



time: 07:35:10 - 17:13:05

Figure 2. Carriage speed in a day

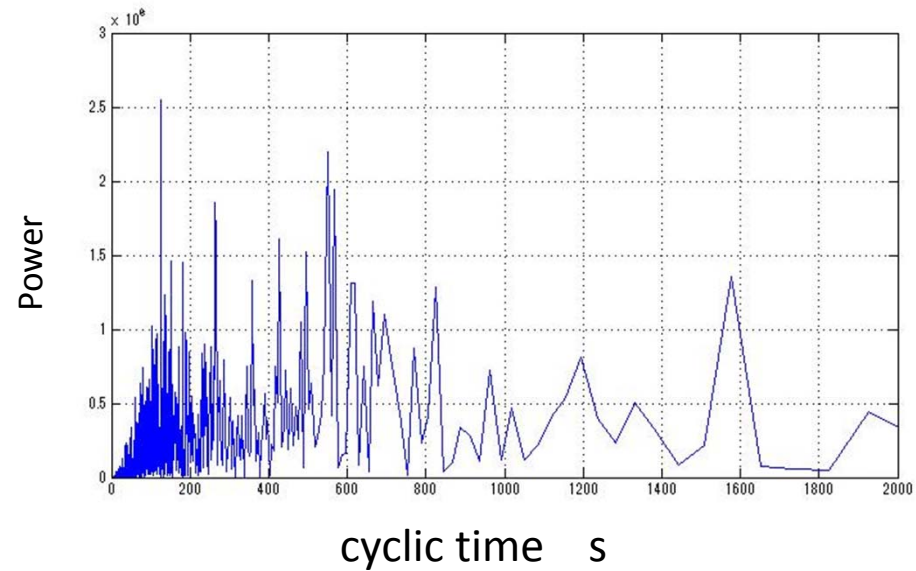


Figure 3. Carriage speed power spectrum by cyclic time
Energy wood yarding

Operation system

- Sub-process A, B and C were connected to show act separately and act at the same time on the same spot. Sub-process A is related to carriage move, sub-process B is related to foreman and sub-process C is related to processor at landing.
- Where sub-process A is as follows,
 - iteration of
 - unloaded carriage haul back,
 - extent choking wire,
 - iteration of
 - log choke
 - wire haul
 - haul wire hoist,
 - loaded carriage haul,
 - unload,
- sub-process B is choking preparation of foreman,
- sub-process C is,
 - iteration of
 - unloading,
 - timber move,
 - timber processing,
 - log assort.
- Additionally, trouble managements and planning discussion occur irregularly.

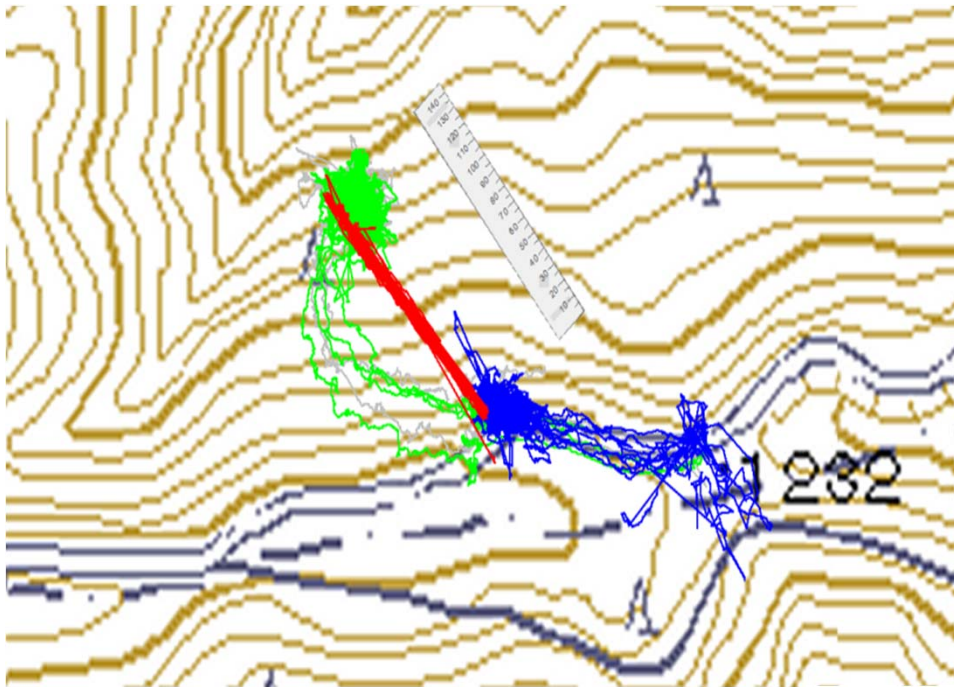


Figure 4. Location of yarding at clear cut of manmade forest

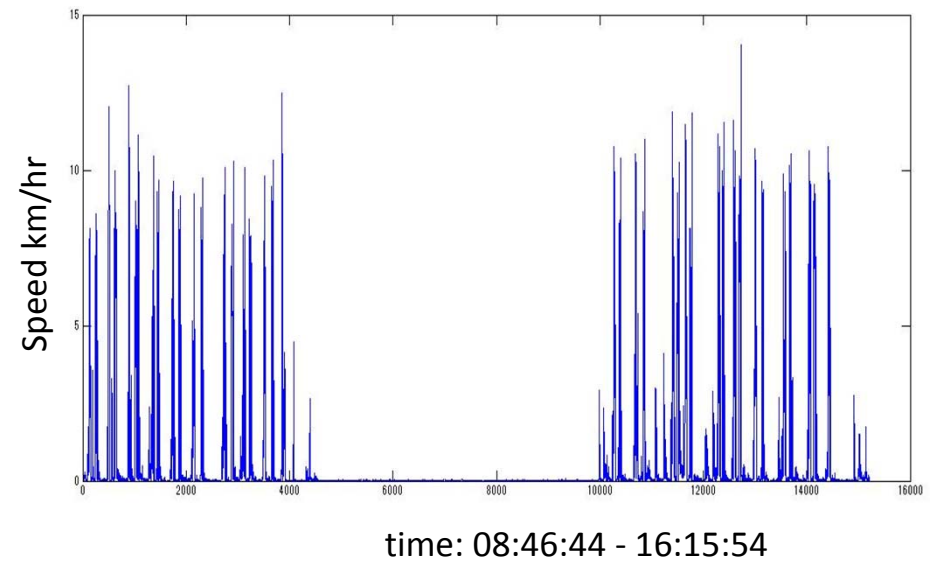
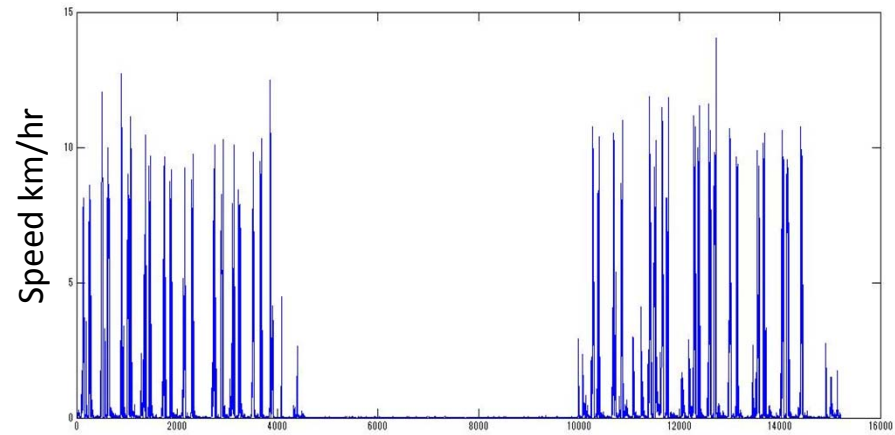


Figure 5. Carriage speed in a day



time: 08:46:44 - 16:15:54

Figure 5. Carriage speed in a day

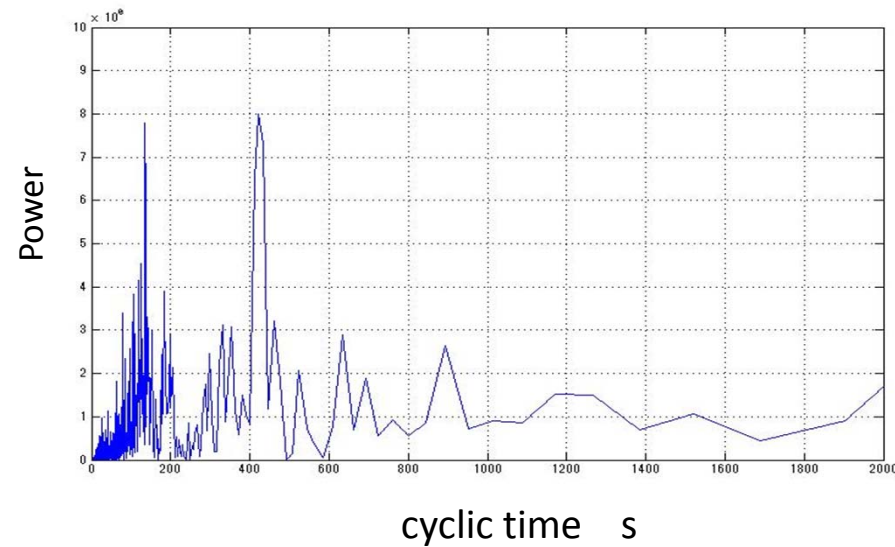


Figure 6. Carriage speed power spectrum by cyclic time
timber wood yarding

Estimation for cycle time and productivity - a simple application

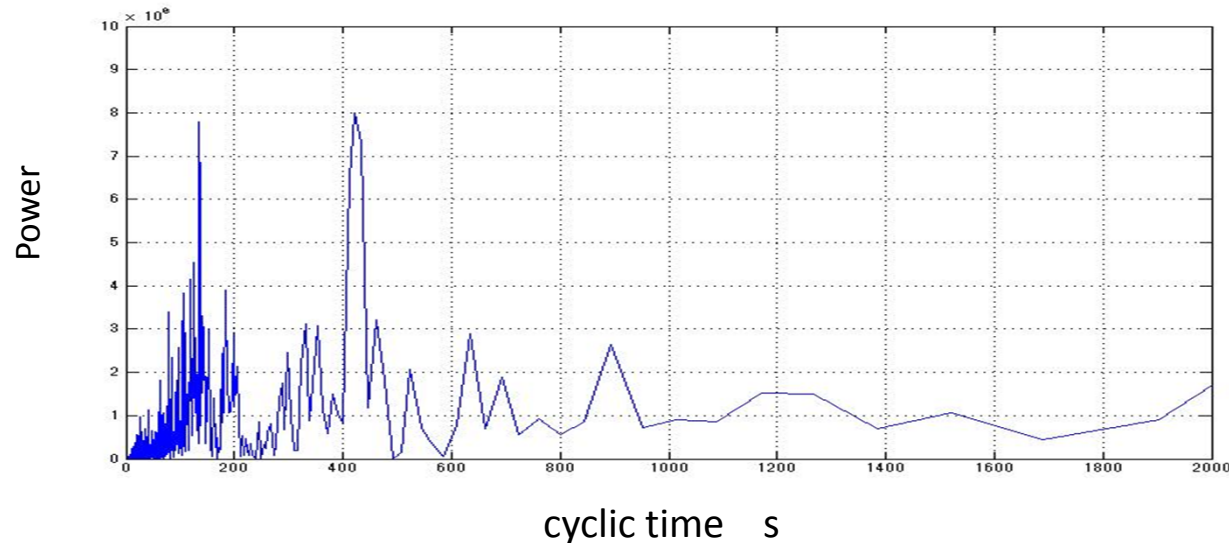


Figure 6. Carriage speed power spectrum by cyclic time
timber wood yarding

- So, one timber yarding cycle needs a unloading, a free carriage forwarding, choking timbers and a loaded carriage hauling run. A cycle yarding time is sum of 120 seconds, 20 seconds, 420 seconds and 30 seconds, following the process above, in simple with the expectation duration time. The one yarding cycle is 590 seconds. And, one load is four full trees, 1.3m^3 . Log conversion rate is 0.65. They produce 5.01 m^3 log per hour. And the two men six hour operation in a day lead to 15.0 m^3 per man day.

Conclusion and prospect

- System operation observation by GPS is useful and the data are valuable to analyze multi points operation. FFT analysis of moving data also useful to find cycle time of operation.
- GPS data are also useful to extract operation system formation by multi acting system components. Interconnection modeling and transition among element processes illustrate numerically the operation space. This also expect to find relationship between operation field condition.