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
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

Figure 2. Carriage speed in a day

time: 07:35:10 - 17:13:05
FFT-Fast Fourier Transform

- Simple wave signal
  - Single frequency

- Imposed multi-frequency signal
  - Multi wave frequency
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
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

• 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, 1.3m³. Log conversion rate is 0.65. They produce 5.01 m³ log per hour. And the two men six hour operation in a day lead to 15.0 m³ 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.