New Approaches to Scheduling Based on Fatigue Modeling

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Homeostatic and Circadian Processes
Drive Fatigue and Modulate Task Performance


Psychomotor Vigilance Test (PVT)
Homeostatic and Circadian Processes Modulate Sleep Propensity during 24/7 Operations

On Duty
(% of total driver hours by hour of the day)

Hour of the Day

1 nighttime period (01:00–05:00) in prior restart break
More than 1 nighttime period in prior restart break

The homeostatic drive for sleep builds up steadily over time awake.

At the same time, the circadian drive for wakefulness diminishes across the night and early morning.

Thus, the two effects amplify each other, and fatigue increases across the work period.

In addition, the circadian process restricts sleep duration during the early evening, making it difficult to get enough sleep each day.

Mathematical Fatigue Models Predict Fatigue or Performance Impairment Based (Solely) on the Neurobiology of Sleep and Fatigue

- measured or predicted light exposure
- circadian process
- sleep inertia
- predicted performance impairment
- effect of chronic sleep loss
- homeostatic process
- planned work/rest schedule
- task workload
- measured or predicted sleep

The Association of Fatigue with Risk of Errors and Accidents Is Multi-Factorial

Toward a Relative Risk Framework to Address the Multi-Factorial Nature of Accident Risk

**Work and Social Hours**

**Risk Factors**
(hazards, work demands, time pressure, distractions, weather, etc.)

**Personal and Environmental Performance Shaping Factors**
(e.g., health, light exposure)

**Relative Risk of Errors, Incidents, Accidents**

**Countermeasures**
(e.g., caffeine, rest breaks, automation, extra staffing)

**RULES, REGULATIONS AND OTHER SCHEDULING CONSTRAINTS**

**A common risk metric:**

Signal-to-Noise Ratio

Sleep, in press.

Fatigue *Distribution* Modeling When Sleep Times Vary

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