Optimising the economic impact of 3D Laser scanning in Copper mining

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Characteristics of Lasers

Gain and Inverse Population

\[
\frac{dI_\nu}{dz} = \left[ N_2 - \frac{g_2}{g_1} N_1 \right] \frac{c^2 g(\nu)}{8\pi\eta^2 \nu^2 \tau_{21}} I_\nu
\]

\[
= \left[ N_2 - (g_2/g_1) N_1 \right] \sigma(\nu) I_\nu
\]

\[
= \gamma(\nu) I_\nu
\]

For four-level laser

\[
\gamma_0 = \sigma_{21} N_{tot} W_p \tau_f (W_p \tau_f + 1) \approx \eta_p \eta_q \eta_a \eta_m \sigma_{21} \tau_f P_{in} \frac{P_{in}}{\hbar \nu \lambda V}
\]

\[
P_{out} = \eta_c \eta_p \eta_q \eta_a \eta_m (P_{in} - P_{th})
\]

\[
P_{th} = \frac{\hbar \nu P A_{eff}}{2 \eta_P \eta_a \sigma_{21} \tau_f} (L_i + T)
\]

For three-level laser

\[
\gamma_0 = \frac{\sigma_{21} N_{tot} (W_p \tau_f - 1)}{(W_p \tau_f + 1)}
\]

\[
P_{out} = \frac{1}{2} \left( 1 - \frac{1}{B} \right) \eta_p \eta_q \eta_a \eta_m \eta_c (P_{in} - P_{th})
\]

\[
P_{th} = \frac{\hbar \nu P A_{eff} \sigma_{21} N_{tot} (B + 1)}{\eta_p \eta_a \sigma_{21} \tau_f (B - 1)}
\]

Boltzmann distribution

\[
N_i = N_{tot} \exp \left( -\frac{E_i}{k_B T} \right)
\]

\[
\frac{N_1}{N_2} = \exp \left( \frac{E_2 - E_1}{k_B T} \right)
\]
Stoping Cycle

Development
Stoping Cycle

Survey

Geology
Stoping Cycle

Survey

Geology
Stoping Cycle
Stoping Cycle

Survey

Geology
Stoping Cycle

1 2 3

Planning
Stoping Cycle

Survey
Stoping Cycle

Mining
Stoping Cycle

Mining Crew
Stoping Cycle

Survey
Lubambe Solutions

Hole Surveys:
The PeeWee is a miniature electronic multishot initially designed for mapping directional core drilling by Devico.
The technology...
How we use this tech...
CMS Units
Optech CMS has been the ideal scanning solution for dangerous and inaccessible cavities in underground mining operations for years, improving safety by letting operators stand clear as the sensor head surveys.

Laser Scanners
The Faro focus3D laser scanner is a high speed laser scanner that collects several million spatial points in a matter of minutes.
The technology...
How we use this tech...
Panel 2 should be observed to cut off holes #1 if need be when cut up.
Benefits…

- Optimized drill design that provides for an exact match between drill rig and drill site.
- Minimized dilution and reduction in associated product cost build up. (Tramming, energy, Processing)
- Pinpoints sources of reduced mining head grade.
- Overall reduction in production cost and increase in quality volumes.
- Fuller utilization of geological information.
- More accurate extraction tonnage estimates measurements
- Utilizes expensive survey equipment in a cost effective manner.
- Changes mining mind set from chasing tons to chasing quality
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