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NASA TECH BRIEF

Marshall Space Flight Center

Pseudotachometer for Mobile Metabolic Analyzer

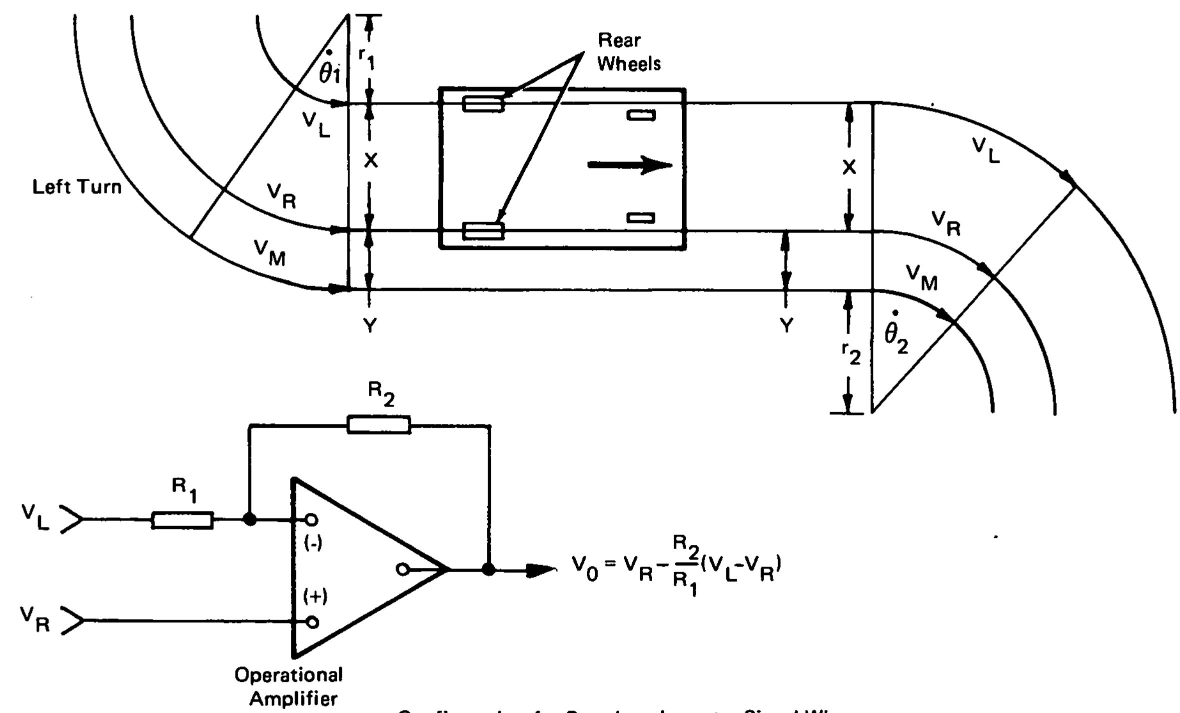
A new mobile metabolic analyzer has been developed which determines a patient's walking or ambulation speed and simultaneously measures his metabolic parameters. The analyzer is designed to move at some preselected human ambulation speed. During a test, a patient is connected to the system and follows the analyzer closely while his metabolic data is being monitored.

Basically, the system comprises an electrical cart, or pseudotachometer, supporting a metabolic analyzer. The cart is designed to travel over a tape track laid out over a prescribed course. As shown in the illustration, the cart has passed a left turn and is moving toward a right turn. The paths shown represent the velocities V_R, V_L, and V_M of the right and left rear wheels and of the patient, respectively. In this case, the patient is walking to the right of the right rear wheel.

The development of the pseudotachometer is based on the following analysis: As shown in the figure, the distances X and Y are constants, while θ and r are unknowns, and the patient's velocity is to be computed.

Using the left turn as reference (see figure) constant angular velocity $\dot{\theta}_1$ may be expressed by

$$\dot{\theta}_1 = \frac{V_L}{r_1} = \frac{V_R}{r_1+X} = \frac{V_M}{r_1+X+Y} \quad (1)$$



Configuration for Pseudotachometer Signal When the Patient is Positioned to the Right of the Cart

(continued overleaf)

By equating the first two expressions on the right-hand side of this equation, r_1 may be expressed as follows:

$$r_1 = \frac{XV_L}{V_R - V_L} \qquad (2)$$

Now, solving the last two expressions on the right-hand side of equation 1 for r_1 reduces r_1 to

$$r_1 = \frac{(X+Y)V_L}{V_M - V_L} \qquad (3)$$

Hence, a substitution for r_1 from equation 3 into equation 4 reduces the solution for V_M to

$$V_M = V_R - \frac{Y}{X}(V_L - V_R) \qquad (4)$$

where all the terms on the right-hand side are either known or can be measured. The same development holds for the right-hand turn. Equation 4 also holds for movement along the straight segment.

Based on equation 4, a pseudotachometer is built using a single operational amplifier with corresponding input-output characteristics (see figure). The velocities of the cart wheels are determined by voltages equivalent to V_L and V_R derived from tachometers installed on the left and right rear wheels, respectively. The resistor ratio, R_2/R_1, then is adjusted to match the distance ratio, Y/X. The output voltage of the amplifier then determines ambulating velocity V_M.

Equation 4 is valid only if the patient is walking to the right of the right rear wheel. Should the patient be walking between the two rear wheels, a different relationship may be obtained using a similar analysis, where

$$V_M = V_R + \frac{R_2}{R_1+R_2}(V_L - V_R) \qquad (5)$$

Note:

Requests for further information may be directed to:

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Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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