Modeling and Analysis; Performance Modeling

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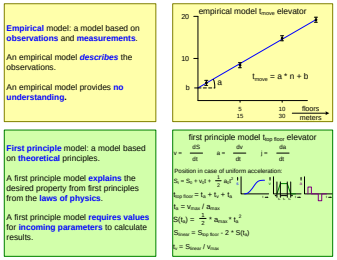
Abstract

Principles and concepts of modeling performance.



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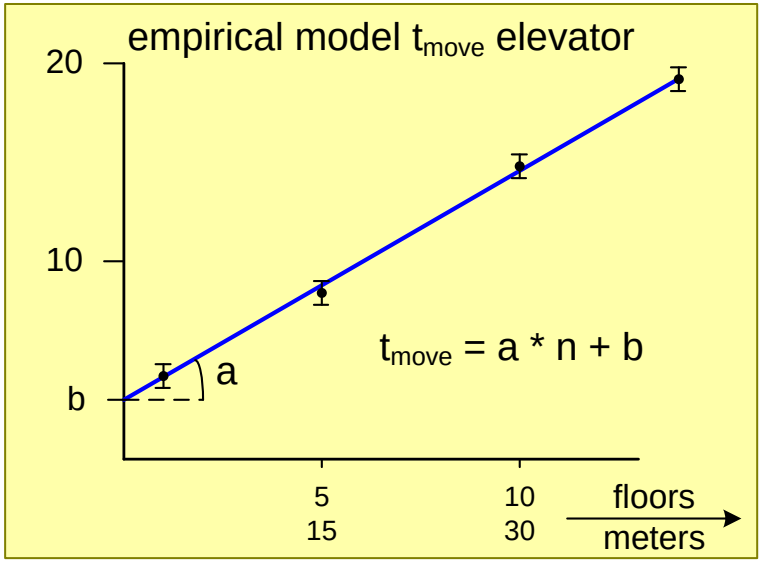
Empirical versus First Principle Models

Empirical model: a model based on **observations** and **measurements**.

An empirical model ***describes*** the observations.

An empirical model provides **no understanding.**



First principle model: a model based on **theoretical** principles.

A first principle model **explains** the desired property from first principles from the **laws of physics**.

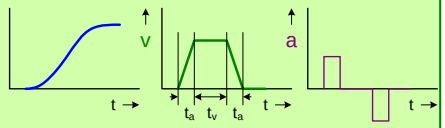
A first principle model **requires values** for **incoming parameters** to calculate results.

first principle model $t_{top\ floor}$ elevator

$v = \frac{dS}{dt}$ $a = \frac{dv}{dt}$ $j = \frac{da}{dt}$

Position in case of uniform acceleration:

$S_t = S_0 + v_0 t + \frac{1}{2} a_0 t^2$



$t_{top\ floor} = t_a + t_v + t_a$

$t_a = v_{max} / a_{max}$

$S(t_a) = \frac{1}{2} * a_{max} * t_a^2$

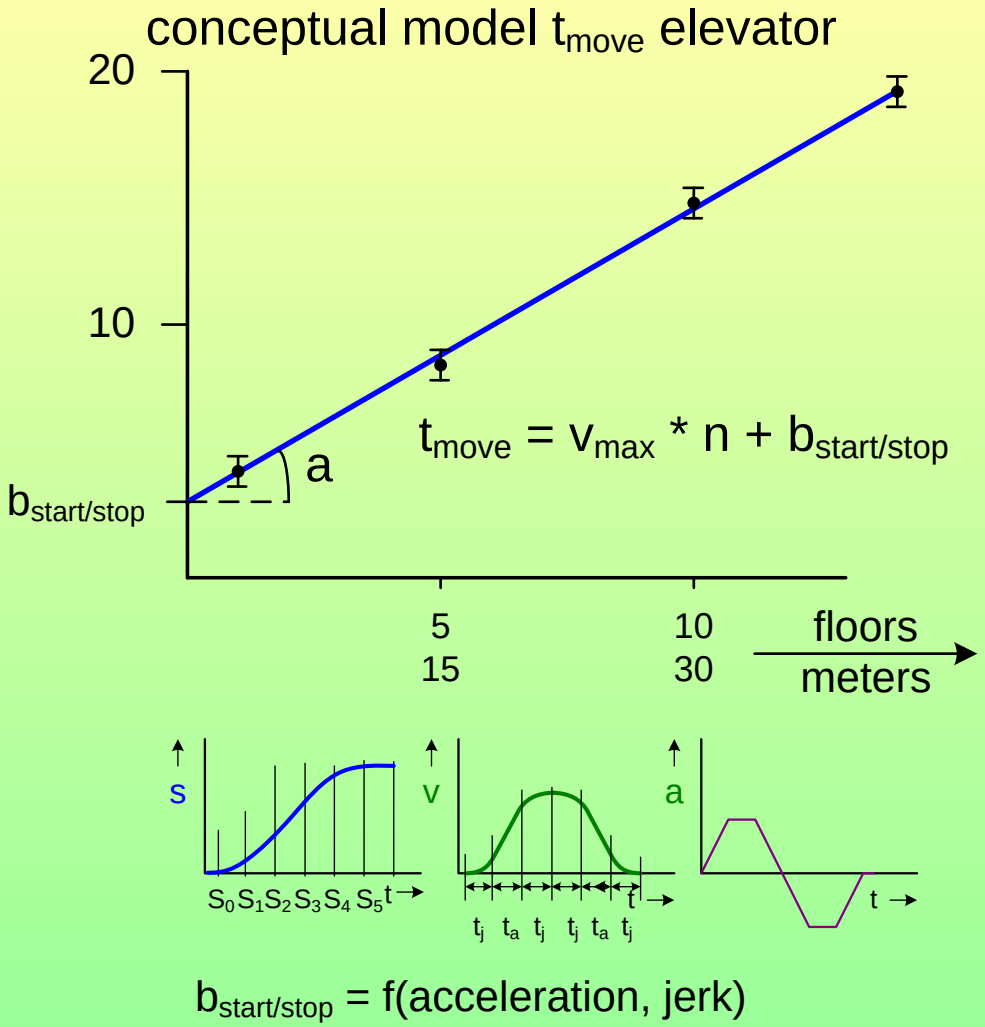
$S_{linear} = S_{top\ floor} - 2 * S(t_a)$

$t_v = S_{linear} / v_{max}$

Conceptual = Hybrid of Empirical and First Principle

Conceptual model: a model **explaining observations** and **measurements** using a selection of **first principles**.

A conceptual model is a **hybrid** of empirical and first principle models; **simple** enough to **understand** and to **reason, realistic** enough to make **sense**.



From Zero to Higher Order Formulas

0^{th} order	main function main parameters	*most simple* *order of magnitude* constant velocity $t_{top\ floor} = S_{top\ floor} / v_{max}$
1^{st} order	add most significant secondary contributions	*improved estimation* constant acceleration $t_{top\ floor} = S_{top\ floor} / v_{max}$ $- a_{max} * t_a^2 / v_{max} + 2 * v_{max} / a_{max}$
2^{nd} order	add next level of contributions	*more accurate, understanding* constant jerk $t_{top\ floor} \sim= S_{top\ floor} / v_{max} - a_{max} * t_a^2 / v_{max}$ $+ 2 * v_{max} / a_{max} + 2 * a_{max} / j_{max}$