**Linearization*:***

Linearization is a linear approximation of a nonlinear system that is valid in a small region around an operating point.

 In the study of [dynamical systems](https://en.wikipedia.org/wiki/Dynamical_system), linearization is a method for assessing the local [stability](https://en.wikipedia.org/wiki/Stability_theory) of an [equilibrium point](https://en.wikipedia.org/wiki/Equilibrium_point) of a [system](https://en.wikipedia.org/wiki/System) of [nonlinear](https://en.wikipedia.org/wiki/Nonlinear) [differential equations](https://en.wikipedia.org/wiki/Differential_equation) or discrete [dynamical systems](https://en.wikipedia.org/wiki/Dynamical_system).[[](https://en.wikipedia.org/wiki/Linearization#cite_note-1)

For example, suppose that the nonlinear function is *y*=*x*2. Linearizing this nonlinear function about the operating point x = 1, y = 1 results in a linear function *y*=2*x*−1.

Linearization is useful in model analysis and control design applications.

Exact linearization of the specified nonlinear Simulink® model produces linear state-space, transfer-function, or zero-pole-gain equations that you can use to:

* Plot the Bode response of the Simulink model.
* Evaluate loop stability margins by computing open-loop response.
* Analyze and compare plant response near different operating points.
* Generate controllers with reduced sensitivity to parameter variations and modeling errors

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**LinearizationSimulink Control Design:**

* You can use Simulink Control Design software to linearize continuous-time, discrete-time, or multirate Simulink models. The resulting linear time-invariant model is in state-space form.
* By default, Simulink Control Design linearizes models using a block-by-block approach. This block-by-block approach individually linearizes each block in your Simulink model and combines the results to produce the linearization of the specified system.
* You can also linearize your system using full-model numerical perturbation, where the software computes the linearization of the full model by perturbing the values of the root-level inputs and states.

The block-by-block linearization approach has several advantages to full-model numerical perturbation:

* Most Simulink blocks have a preprogrammed linearization that provides an exact linearization of the block.
* You can use linear analysis points to specify a portion of the model to linearize.
* You can configure blocks to use custom linearizations without affecting your model simulation.
* You can obtain detailed diagnostic information.

**Model Requirements for Exact Linearization:**

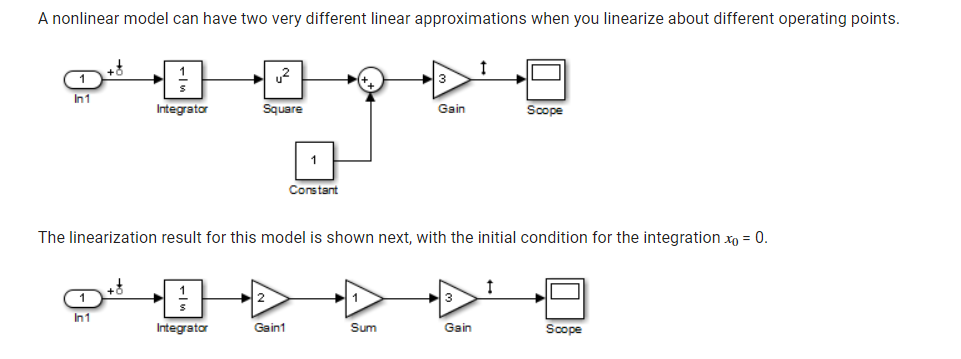
Exact linearization supports most Simulink blocks.

* However, Simulink blocks with strong discontinuities or event-based dynamics linearize (correctly) to zero or large (infinite) gain.
* Models that include event-based or discontinuous behavior require special handling by Simulink Control Design software. Such event-based or discontinuous behavior can come from blocks such as:
  + - Blocks from Discontinuities library
    - Stateflow® charts
    - Triggered subsystems
    - Pulse width modulation (PWM) signals

**Operating Point Impact on Linearization:**

* An operating point of a dynamic system defines the states and root-level input signals of the model at a specific time.
* Choosing the right operating point for linearization is critical for obtaining an accurate linear model. The linear model is an approximation of the nonlinear model that is valid only near the operating point at which you linearize the model.

Although you specify which Simulink blocks to linearize, all blocks in the model affect the operating point.

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