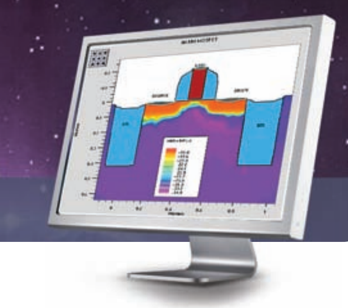
Noise

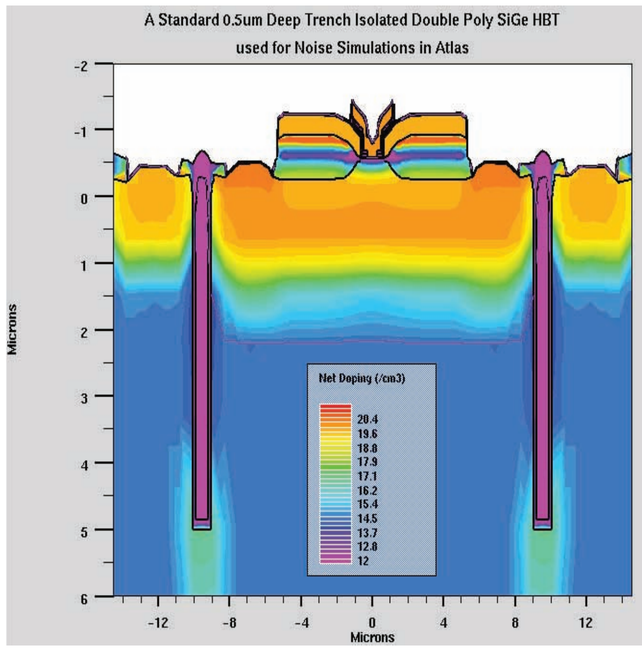


2D Small-Signal Noise Simulator

Noise combined with S-Pisces or Blaze allows analysis of the small-signal noise generated within semiconductor devices. Noise provides accurate characterization of all small-signal noise sources and extracts figures of merit which are essential for optimizating circuit design.

Advanced Semiconductor Noise Analysis

- Noise simulations may be performed on any one or two-port device and supports all material systems within the Atlas framework
- Noise sources modeled include; diffusion noise, generation-recombination noise, and flicker (1/f) noise for both electrons and holes
- Direct extraction of standard industry figures of merit such as minimum noise figure F_{min}, optimum source impedence Z_0, and noise conductance g_n
- Additional outputs include individual microscopic noise sources, the total local noise source, the impedence field and short-circuit Green's function
- Noise voltage correlation spectra due to local microscopic noise sources are modeled using a fast and efficient implementation of the direct impedence field method
- Noise may be applied to either the drift-diffusion equations or the more sophisticated hydrodynamic transport models
- Noise provides ease of use with no user calibration required for diffusion noise or GR noise
- Seamless interface to the Silvaco C-Interpreter module allows users to implement new and unique noise source equations



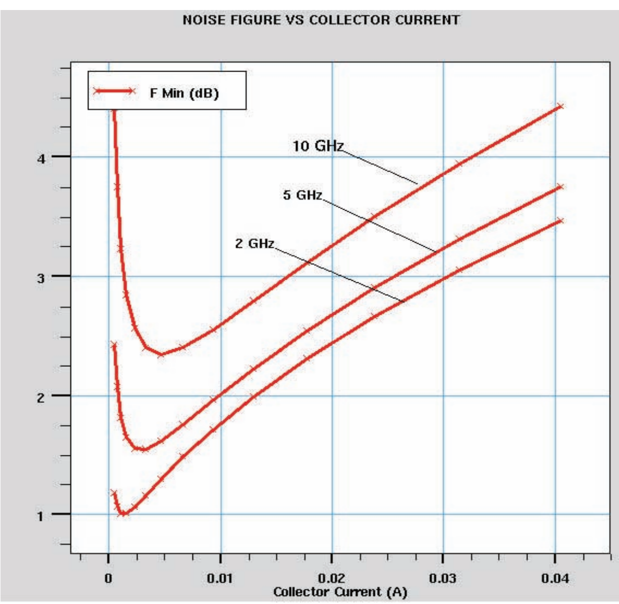
A 0.5um deep trench isolated double poly SiGe HBT with an emitter area of 40um^2 simulated using the 2D process simulator Athena.

Noise Analysis of two-port Devices

Noise provides the ability to investigate and optimize the noise behavior at any operating bias point. Of prime concern to RF engineers is the trade off between achieving a low noise figure, a high operating current and a sufficiently high current gain.

SiGe HBT Example

A trench isolated double poly SiGe HBT was simulated using the process simulator Athena and then was passed to Atlas for noise analysis at various bias points.



Minimum noise figure verses collector current for the poly SiGe HBT at three frequencies of interest for wireless applications-2, 5 and 10 GHz.

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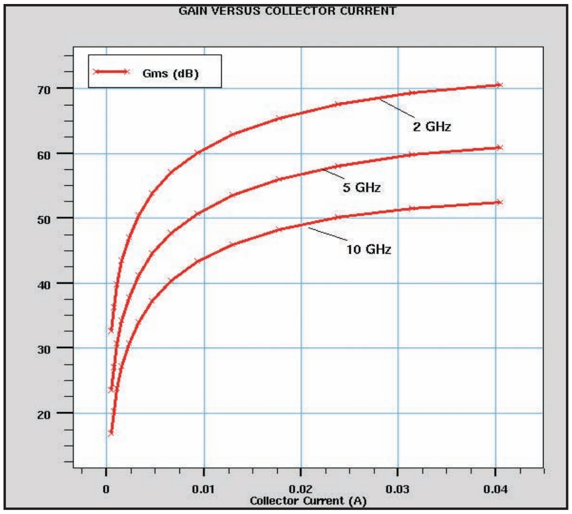
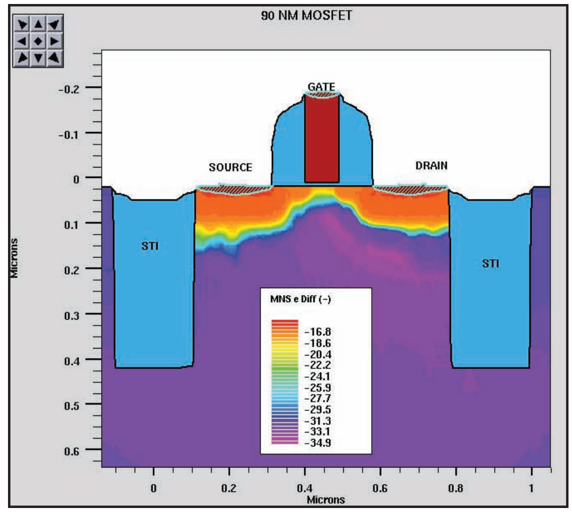


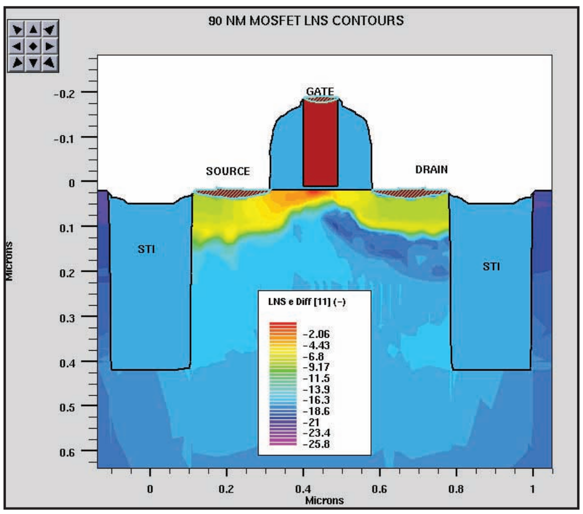
Gain verses collector current for the poly SiGe HBT at three frequencies of interest for wireless applications-2, 5 and 10 GHz.

The two-dimensional contours of the electron microscopic diffusion noise source (MNS) is shown in this figure. The MNS is the amount of noise generated by the volume of the device surrounding a node.



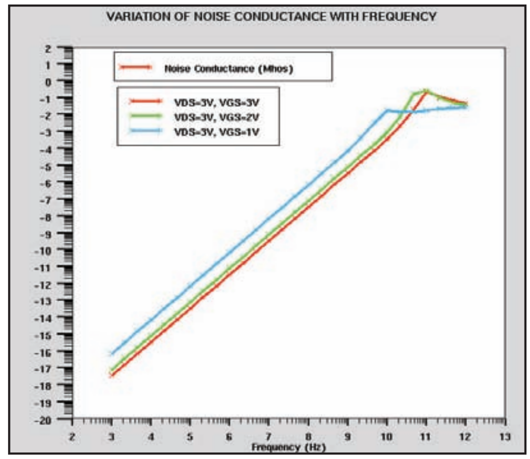
90nm MOSFET Example

A 90nm silicon MOSFET was simulated using the 2D process simulator Athena to provide an accurate description of the physical structure. The structure is then seamlessly passed to the device simulator Atlas for noise analysis for various operating points.

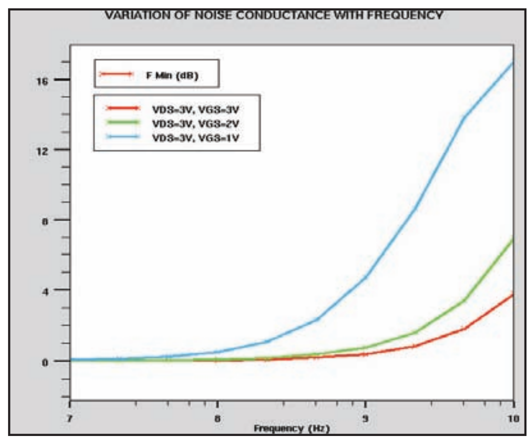


The two-dimensional contours of the electron local diffusion noise source (LNS) is shown in this figure. The LNS is the amount of noise generated on a contact by the volume of the device surrounding a node. This is calculated by translating the MNS into a contact voltage using the impedance field.

Variation of the noise conductance with frequency. The noise conductance is a measure of how the noise figure increases as the source impedance moves away from the optimum source impedance.



Two-port noise figure F_{min} as the frequency is varied from 1kHz to 10GHz. The noise figure is a measure of the extra noise that the device adds to the signal reaching the load. It is defined as the noise power delivered to the load, but the noisy source and the noisy device, divided by the noise power that would be delivered to the load if the source were noisy but the device was ideal.



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