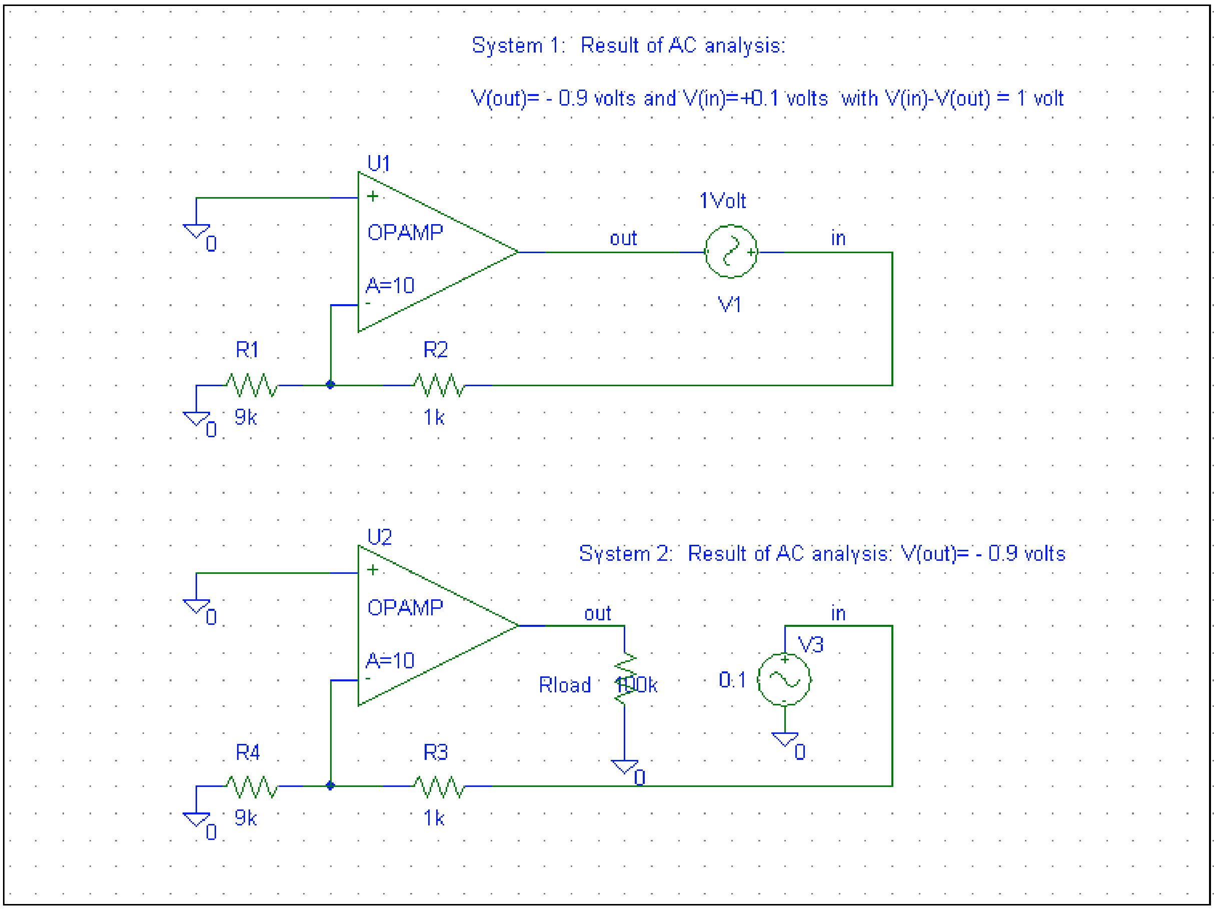
Is the Middlebrook method for loop gain determination an open-loop procedure?



- Example: Ideal amplifier with a gain of A=10. Negative resistive feedback with $\beta=9/10$.

- Loop gain: $T=-0.9\cdot 10=-9$

- Middlebrook (see system 1, above):
  As a result of an ac analysis we get two voltages **V(out)=-0.9 V and V(in)=0.1 V**

- Classical method (see system 2, above): **V(out)=-0.9 V for V(in)=0.1 V**

- Conclusion: The Middlebrook method is identical to an ac open-loop simulation

- Advantage (explanation) of Middlebrook's method:
  It looks as if the feedback path remains closed. However, this is true only for dc (that's the advantage as the bias point remains unchanged). The ac source decouples both nodes ("out" and "in") and allows two ac voltages determined by the loop gain. These voltages, of course, are identical to the values resulting from a "true" opening of the loop. **Thus, Middlebrook's method is in fact an open-loop simulation**.

- Remark: The result of this single simulation is correct only because the output resistance Rout of the ideal model is zero. Otherwise, there is an error because of a voltage drop across Rout caused by the test voltage. This error can be compensated (during evaluation of the results) by a second simulation run using an ac current source instead of an ac voltage source.