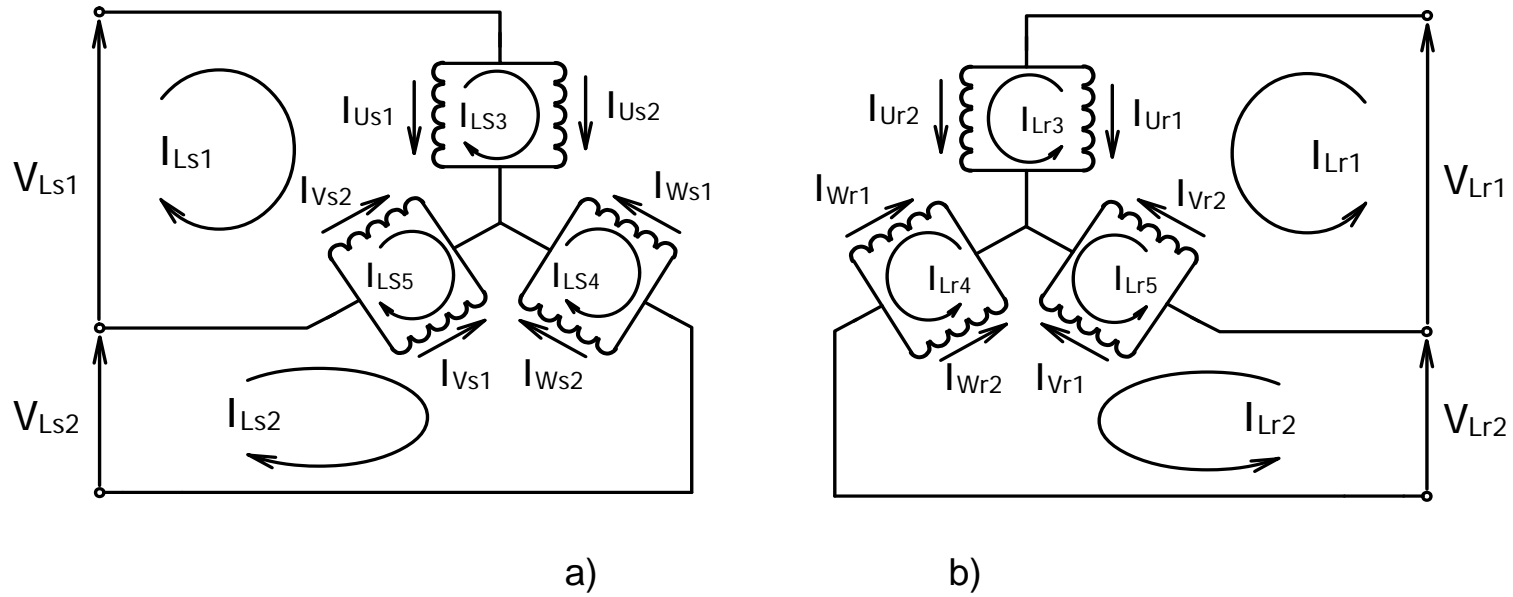


# Effects of supply unbalances, speed variation, inertia and winding faults on the frequency content of DFIG quantities

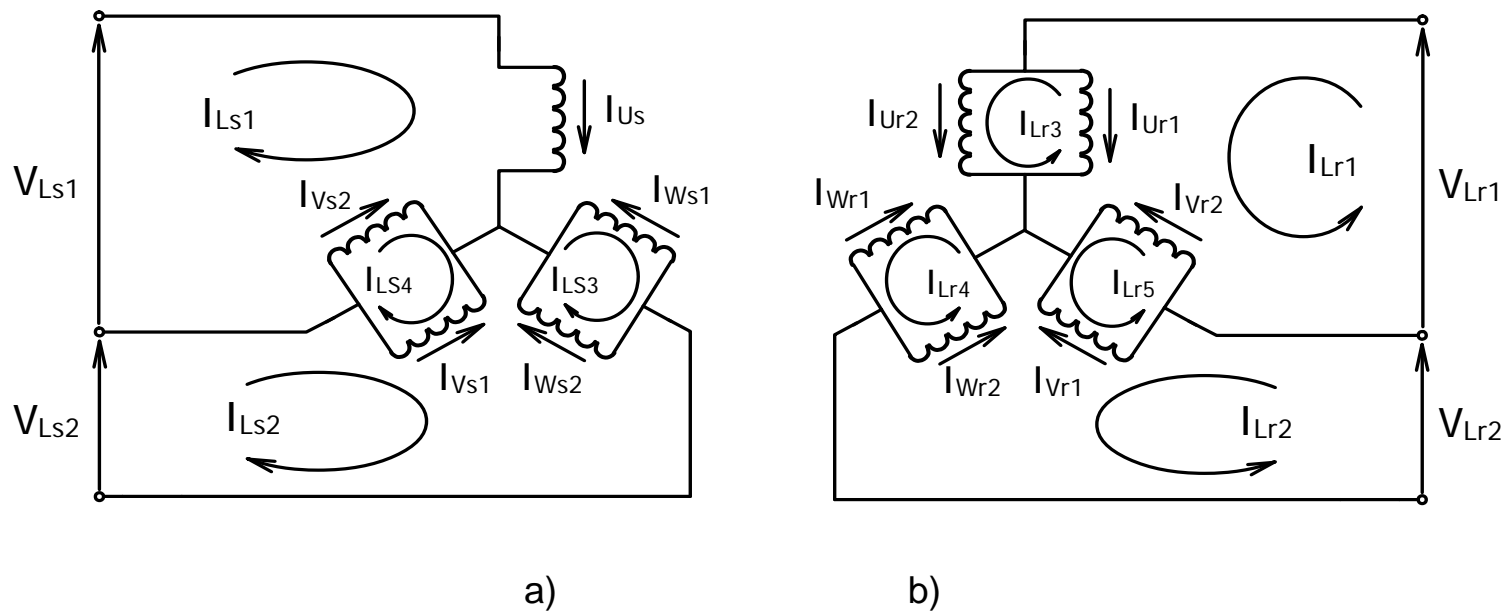
Department of Electrical Engineering and Electronics  
The University of Manchester

# Healthy DFIG



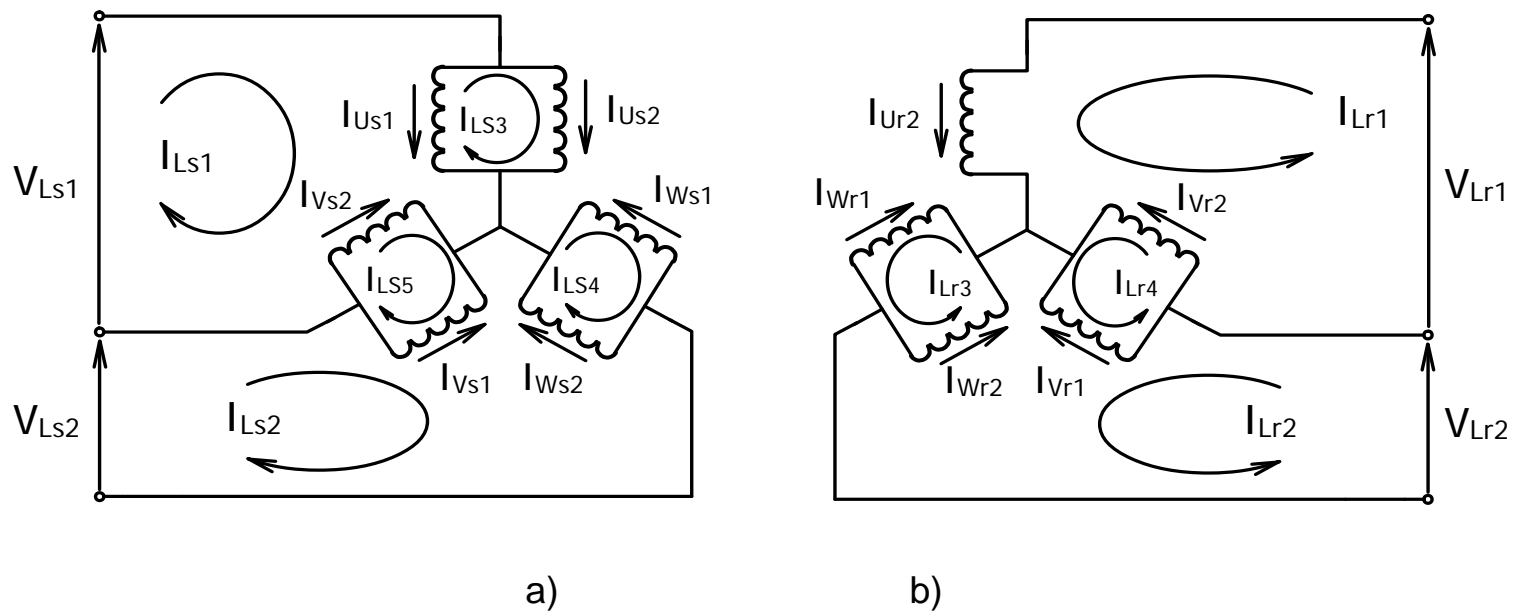
DFIG stator and rotor circuit diagram:  
a) stator in parallel      b) rotor in parallel

# Stator Open-circuit Fault



DFIG stator and rotor circuit diagram:  
 a) Open circuit fault in stator phase U      b) Healthy rotor windings

# Rotor Open-circuit Fault

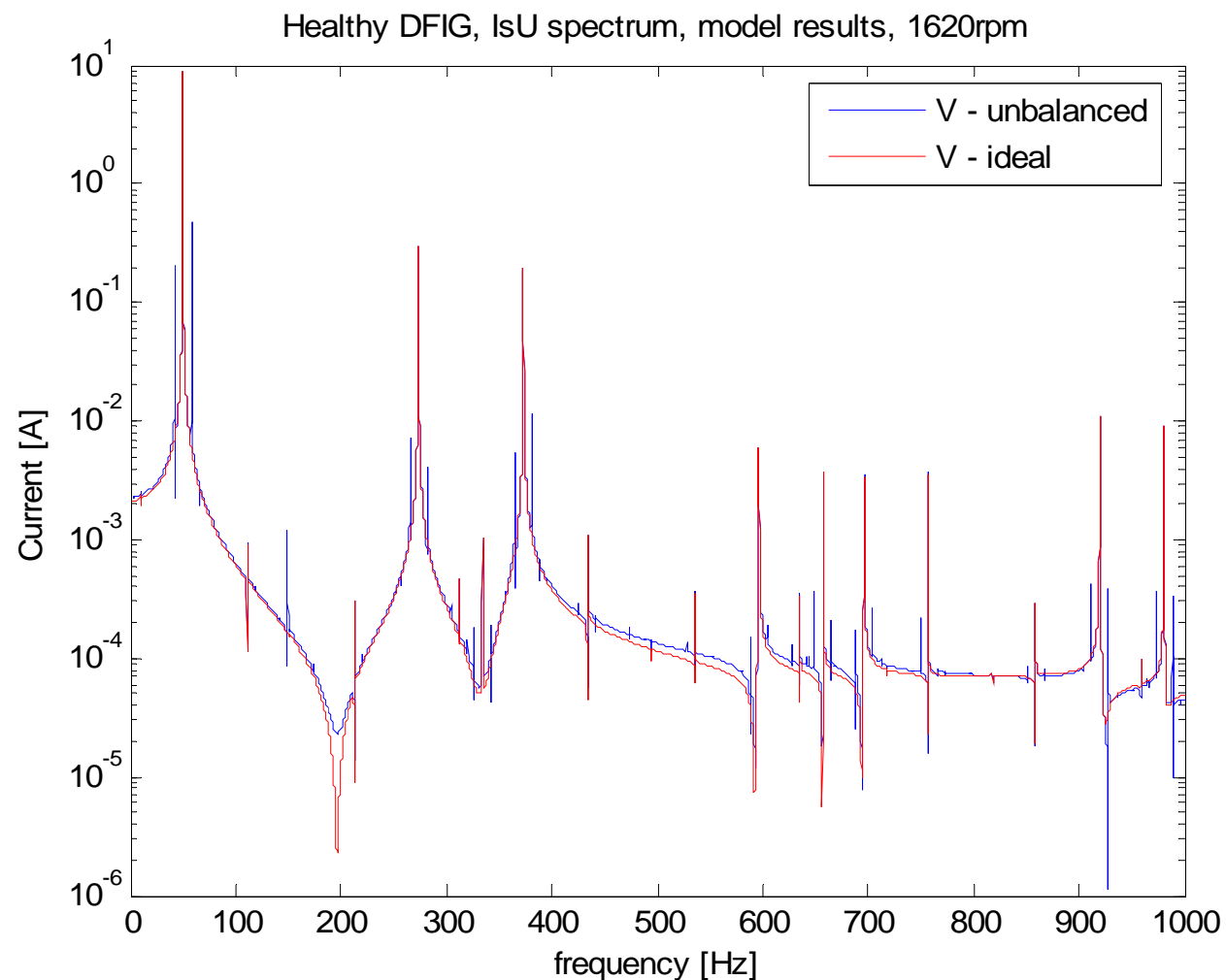


DFIG stator and rotor circuit diagram:

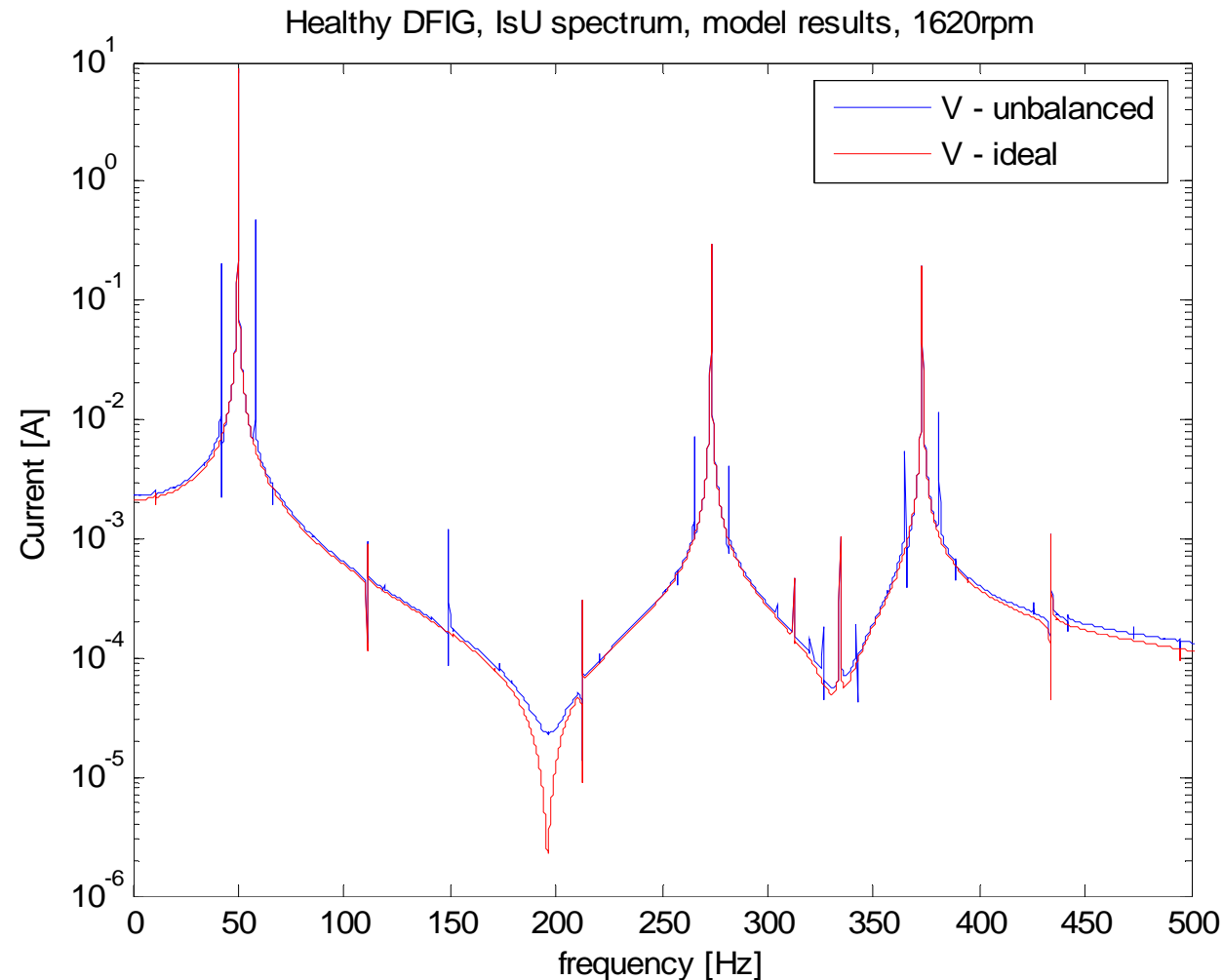
a) Healthy stator windings

b) Open circuit fault in rotor phase U

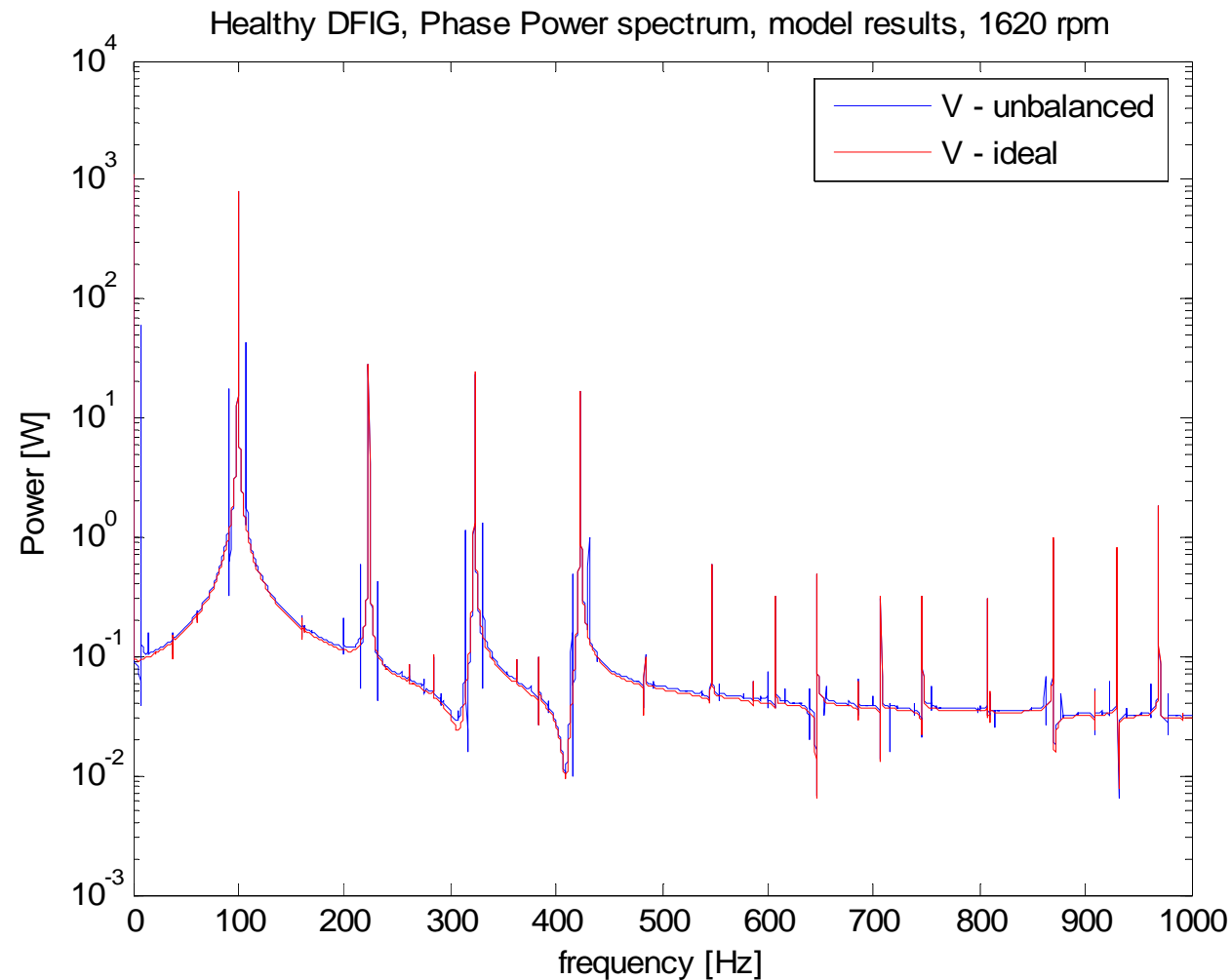
# The effect of voltage supply unbalances (stator & rotor) on the stator current spectrum of a healthy DFIG



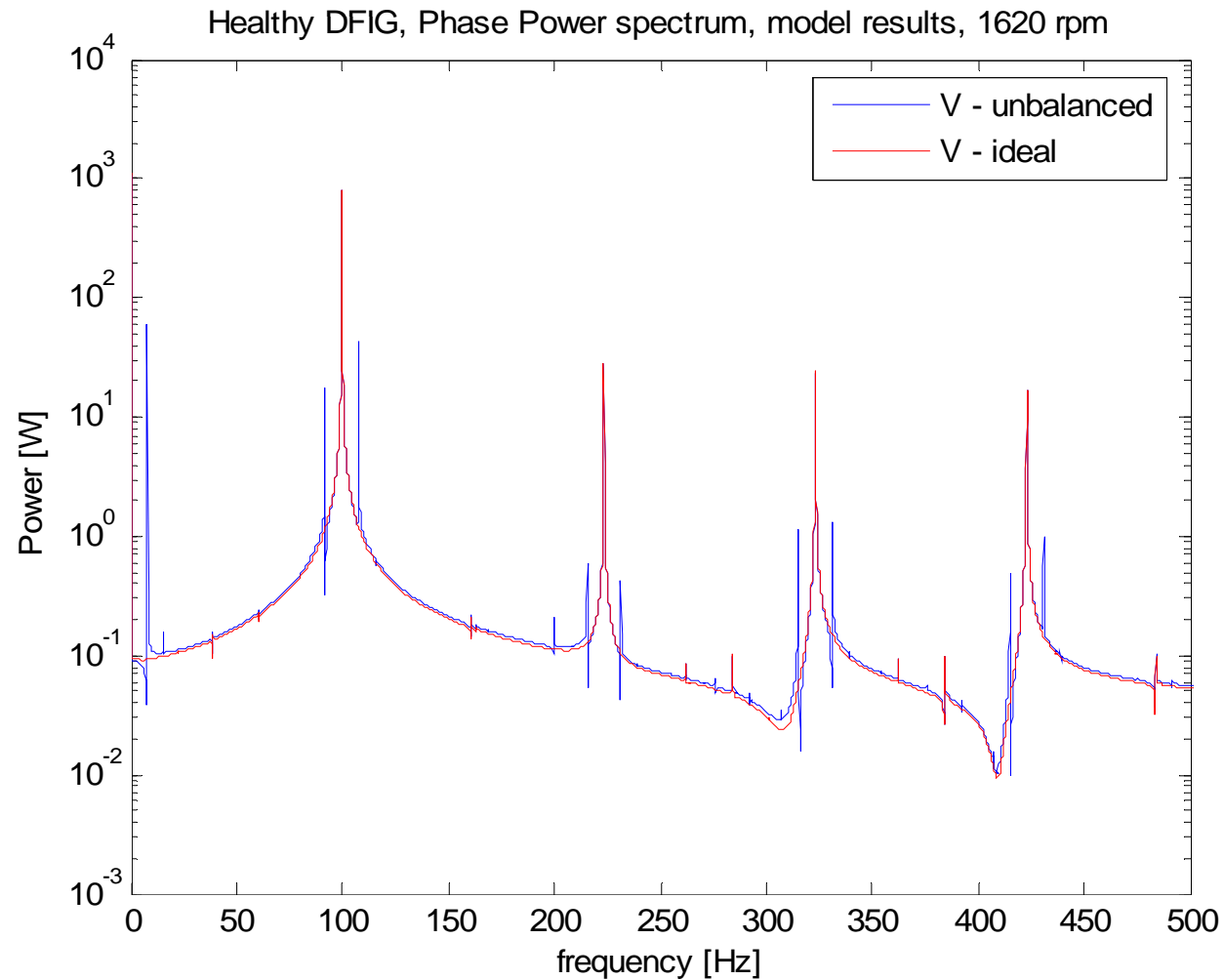
# The effect of voltage supply unbalances (stator & rotor) on the stator current spectrum of a healthy DFIG



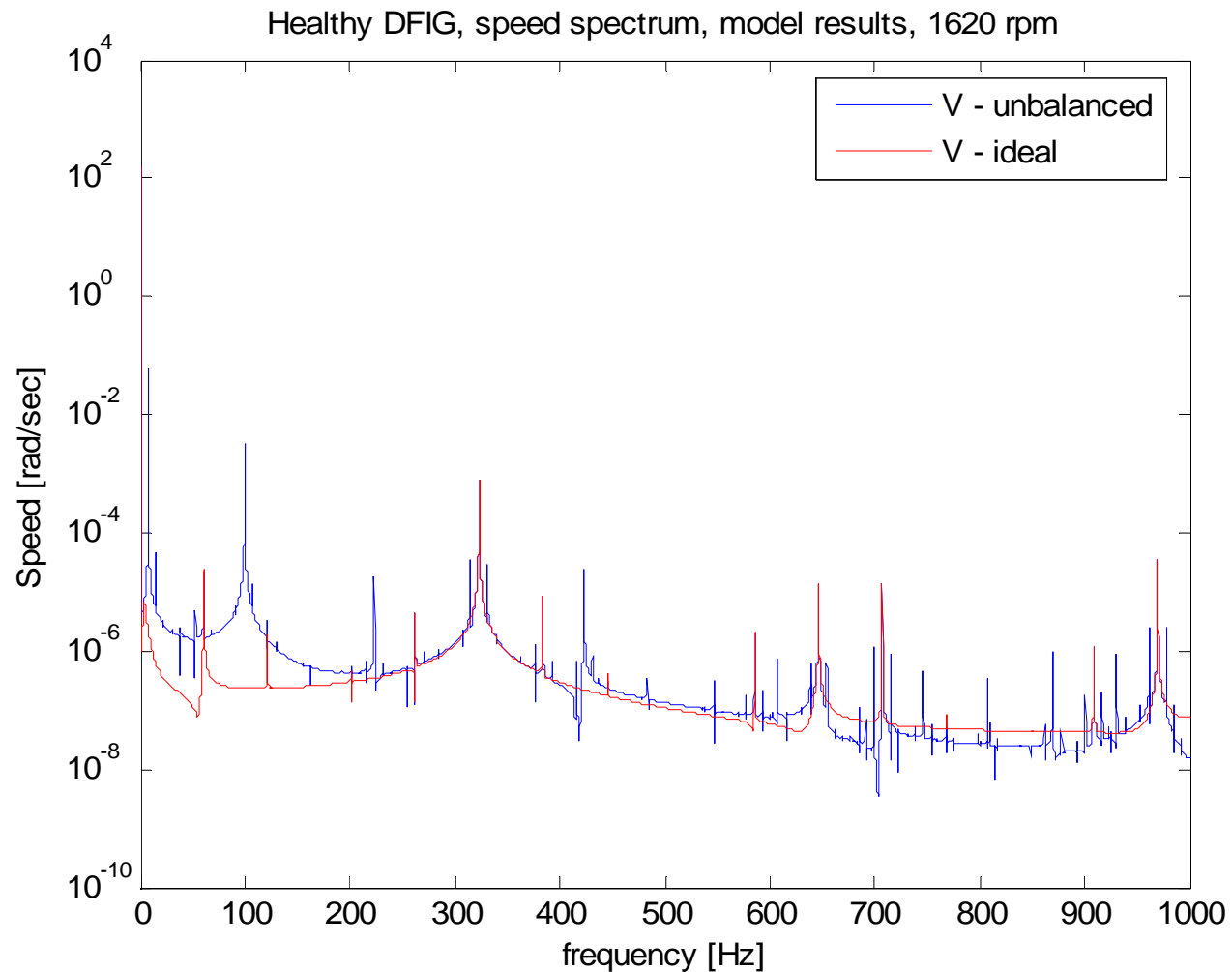
# The effect of voltage supply unbalances (stator & rotor) on the phase power spectrum of a healthy DFIG



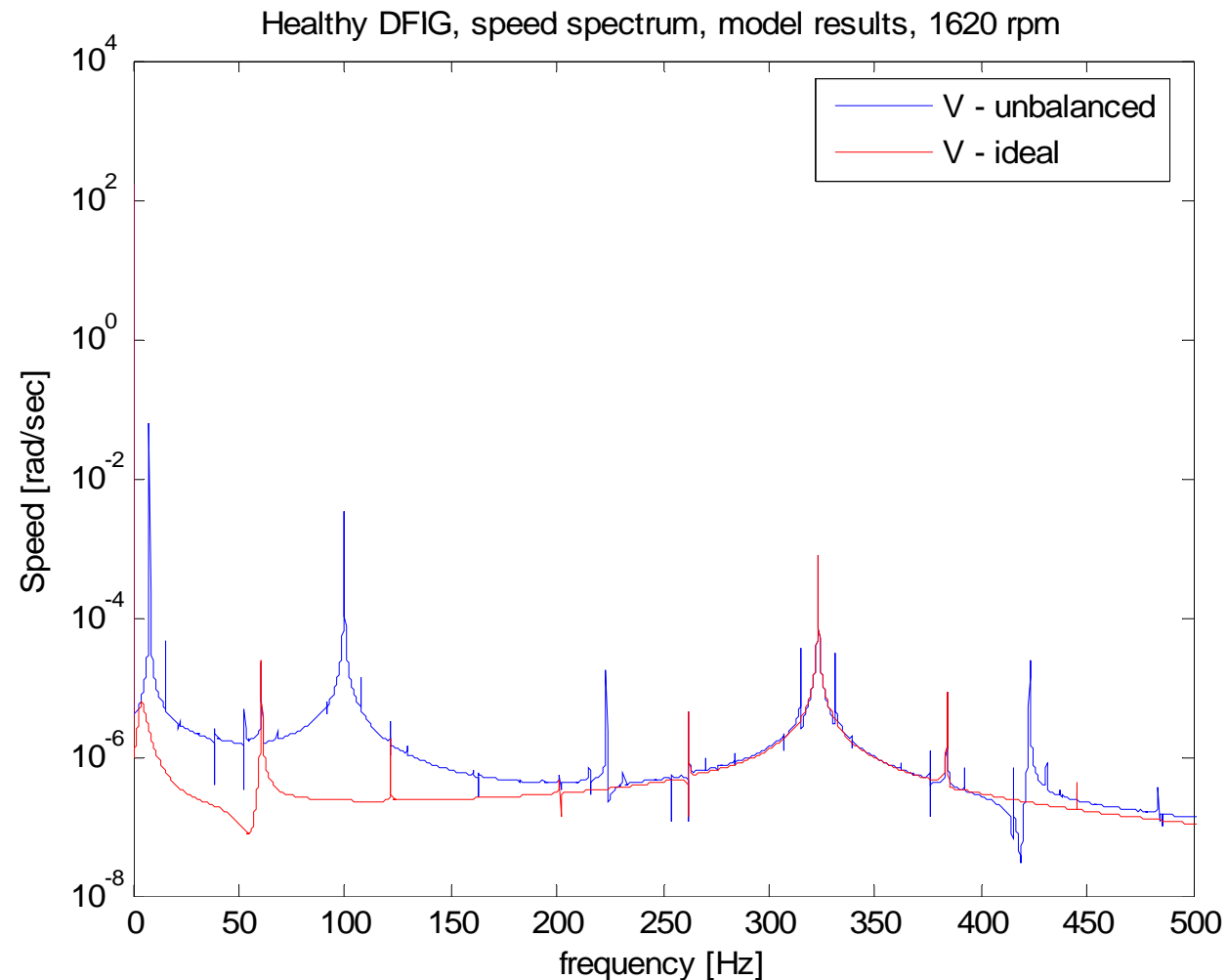
# The effect of voltage supply unbalances (stator & rotor) on the phase power spectrum of a healthy DFIG



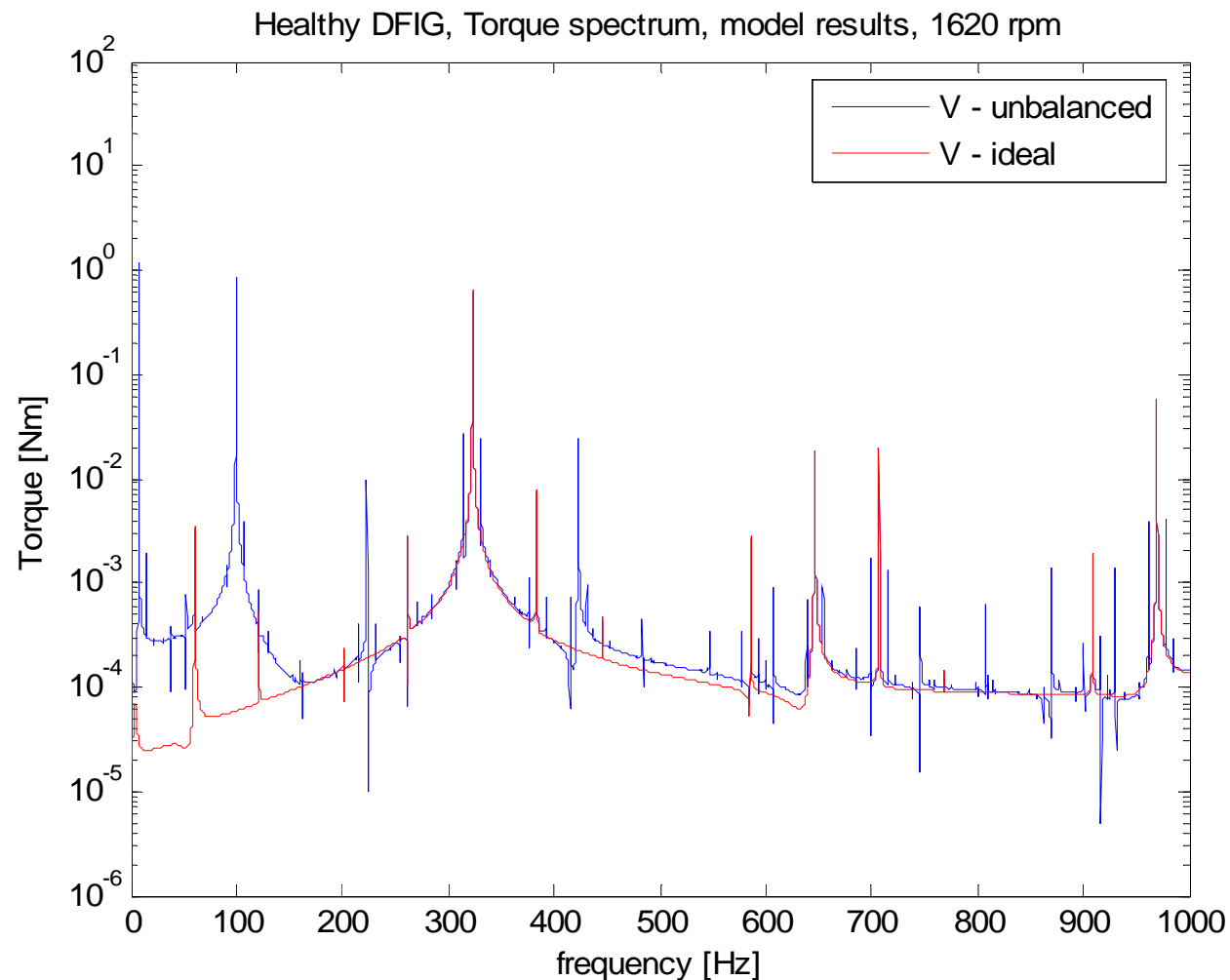
# The effect of voltage supply unbalances (stator & rotor) on the speed spectrum of a healthy DFIG



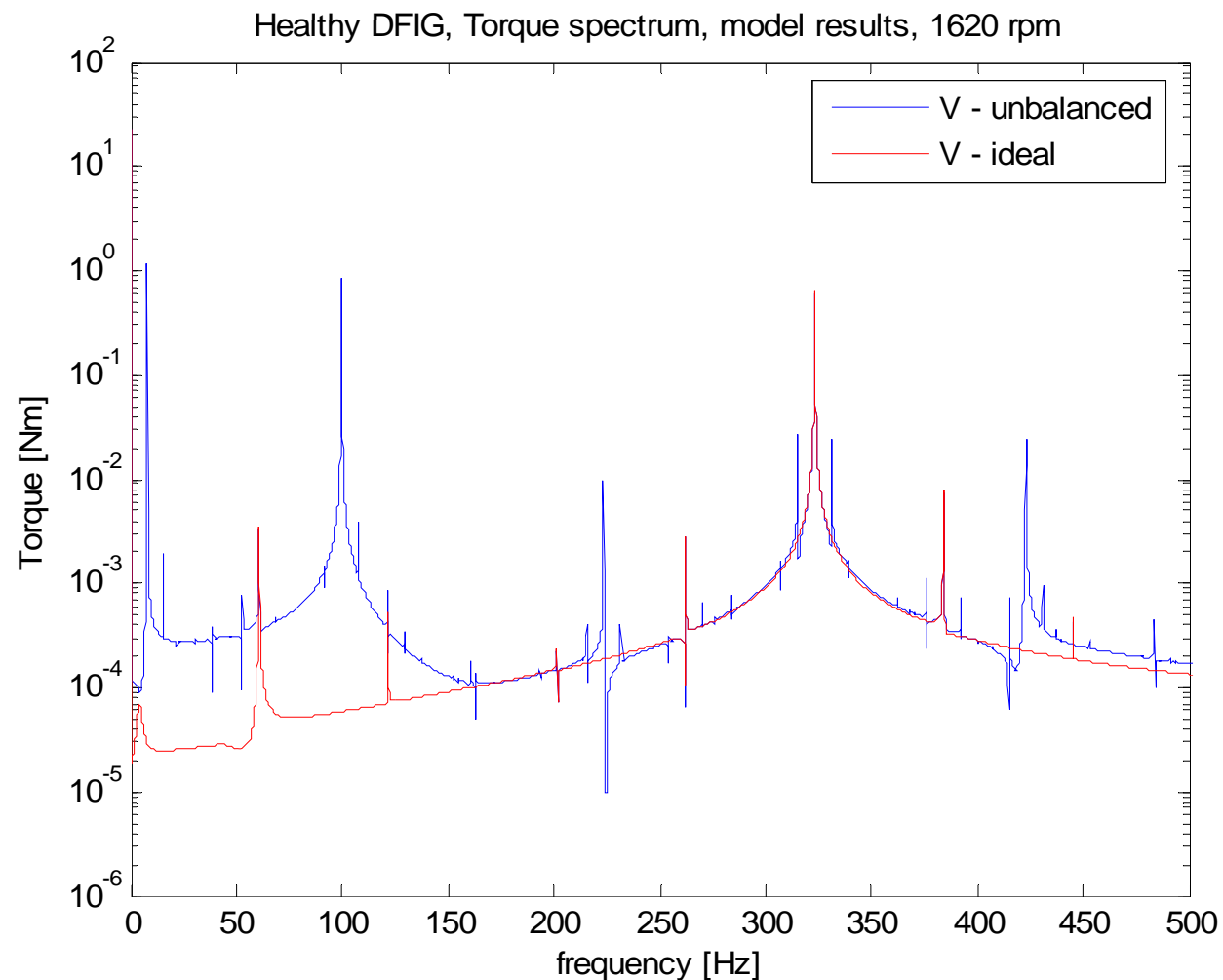
# The effect of voltage supply unbalances (stator & rotor) on the speed spectrum of a healthy DFIG



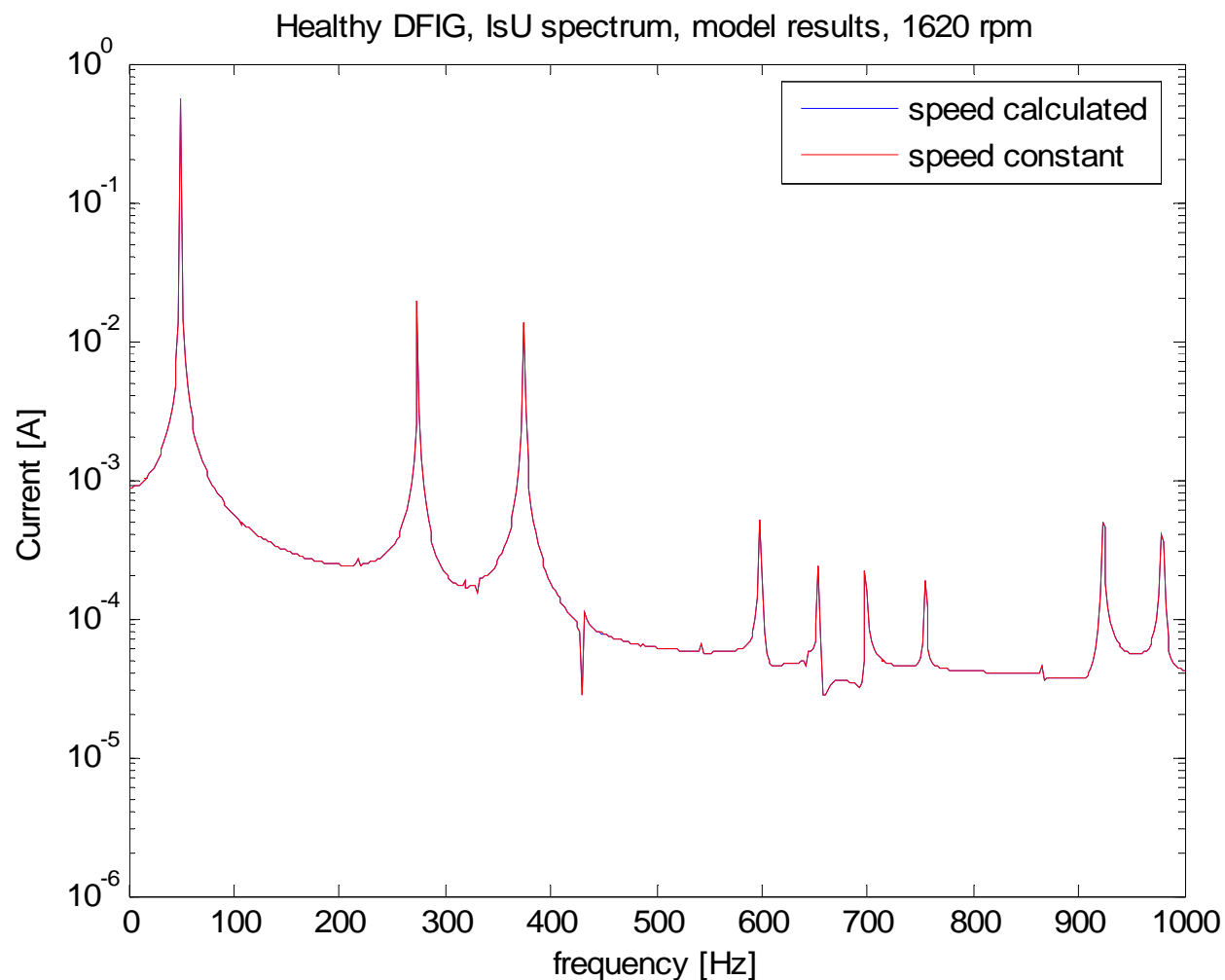
# The effect of voltage supply unbalances (stator & rotor) on the torque spectrum of a healthy DFIG



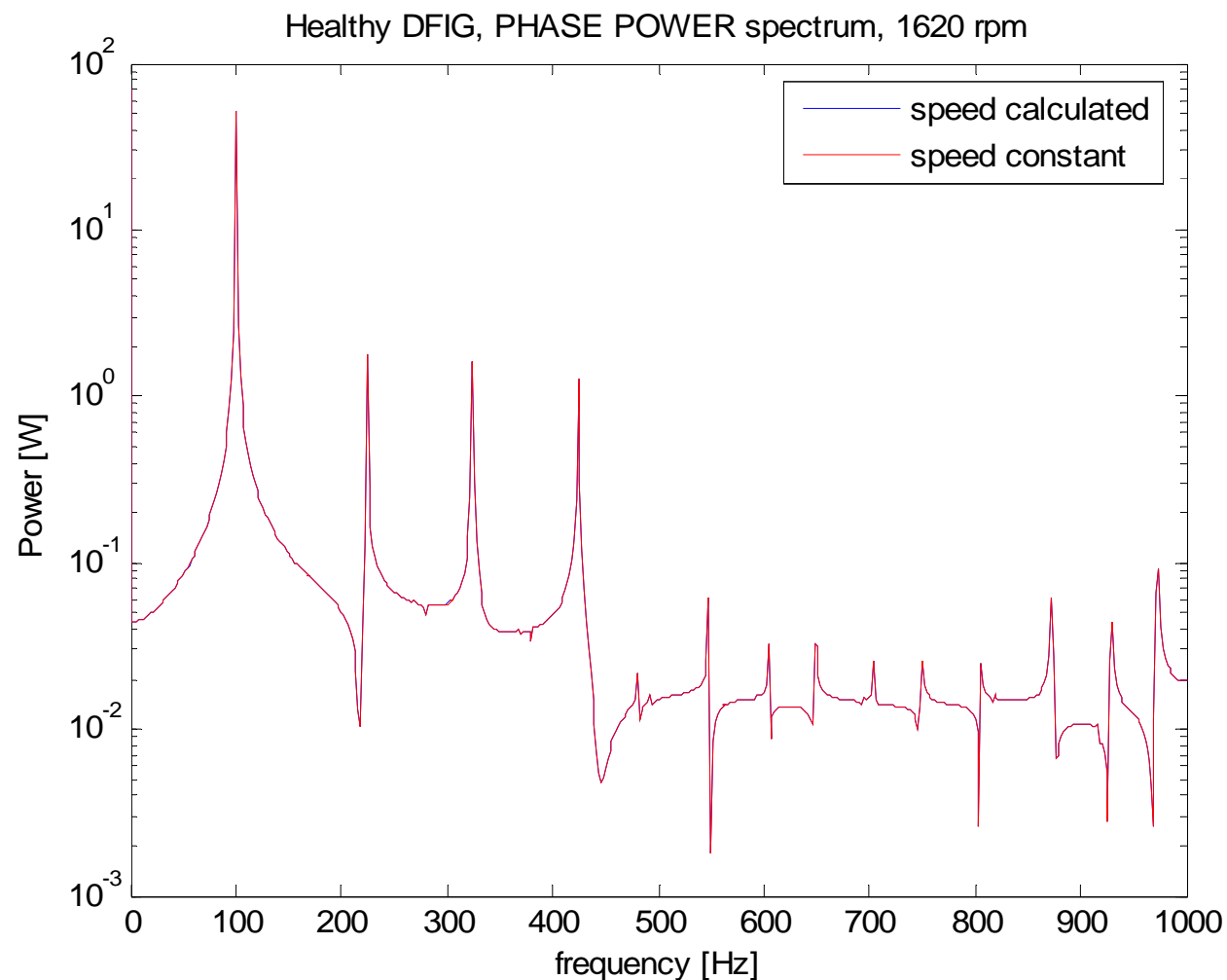
# The effect of voltage supply unbalances (stator & rotor) on the torque spectrum of a healthy DFIG



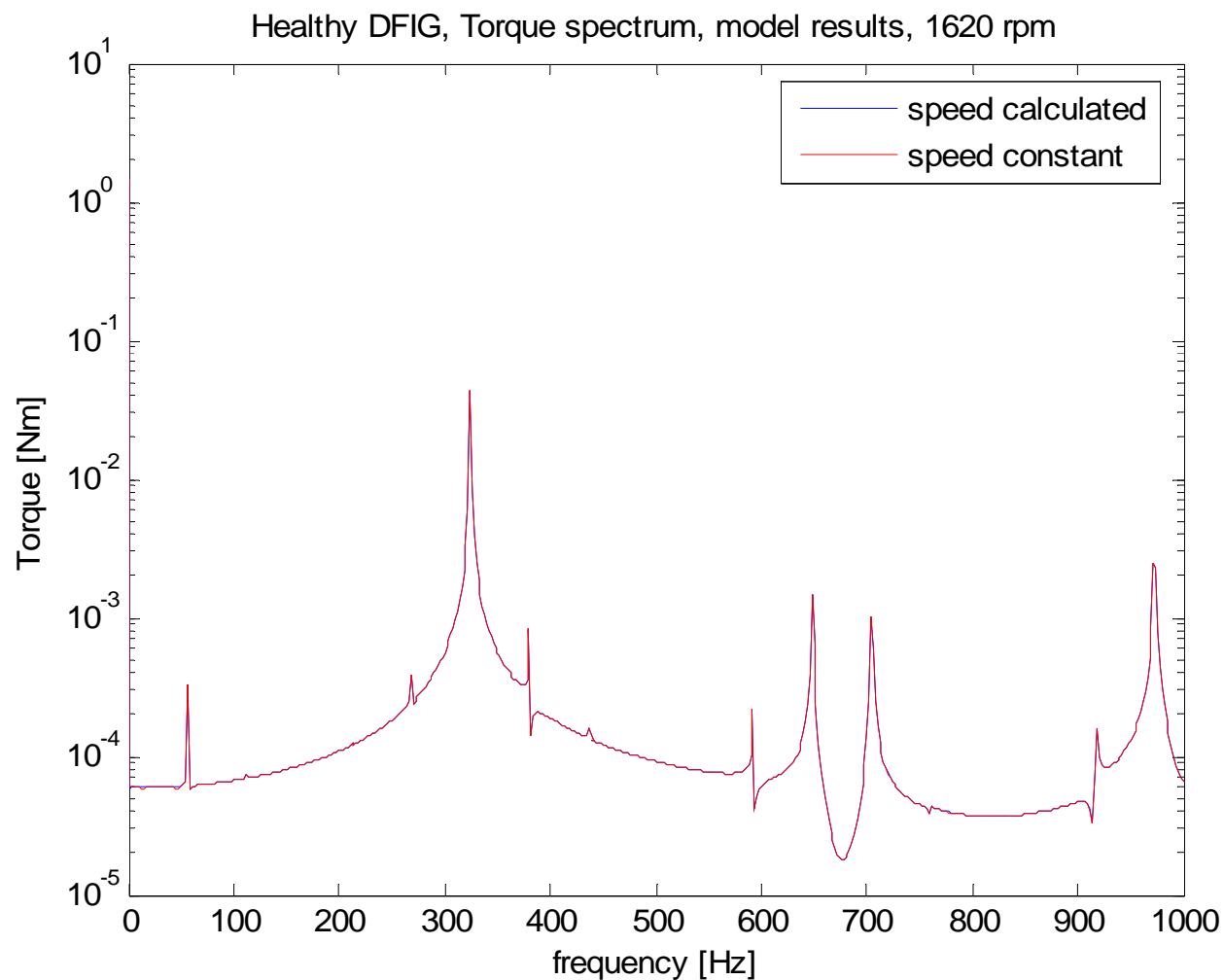
# The effect of the method of speed determination on model results, current spectrum (ideal voltage supply assumed, healthy DFIG)



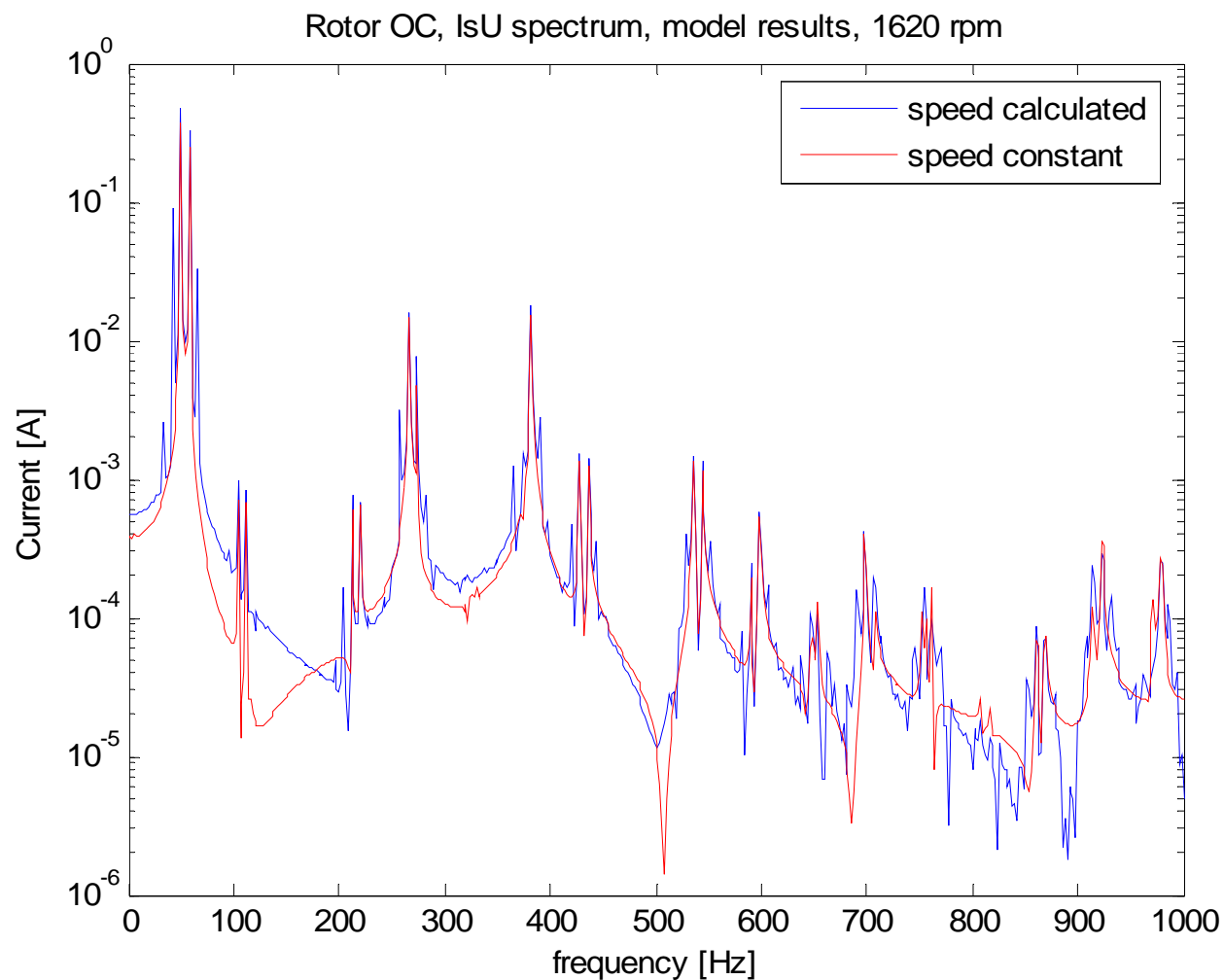
# The effect of the method of speed determination on model results, Power spectrum (ideal voltage supply assumed, healthy DFIG)



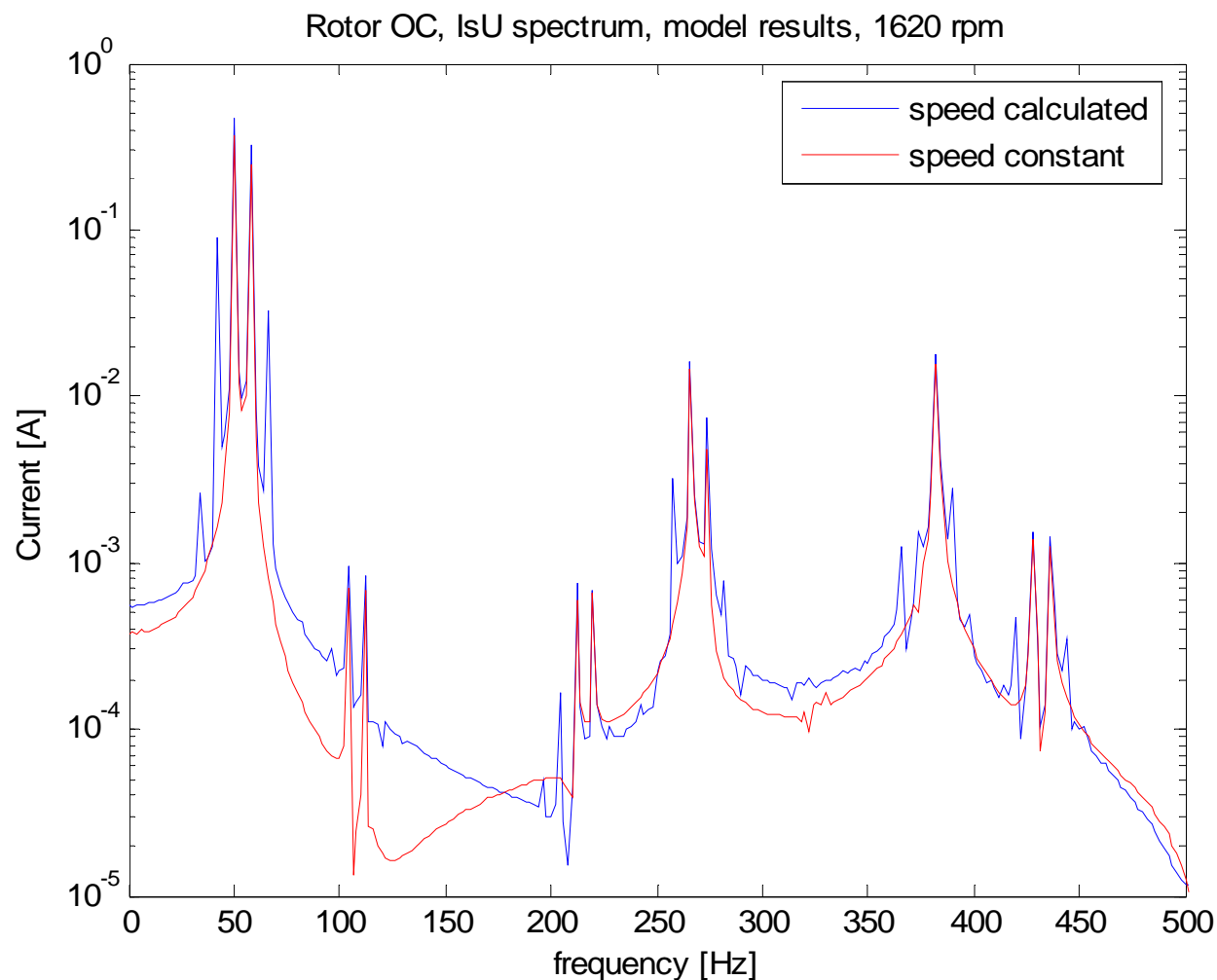
# The effect of the method of speed determination on model results, Torque spectrum (ideal voltage supply assumed, healthy DFIG)



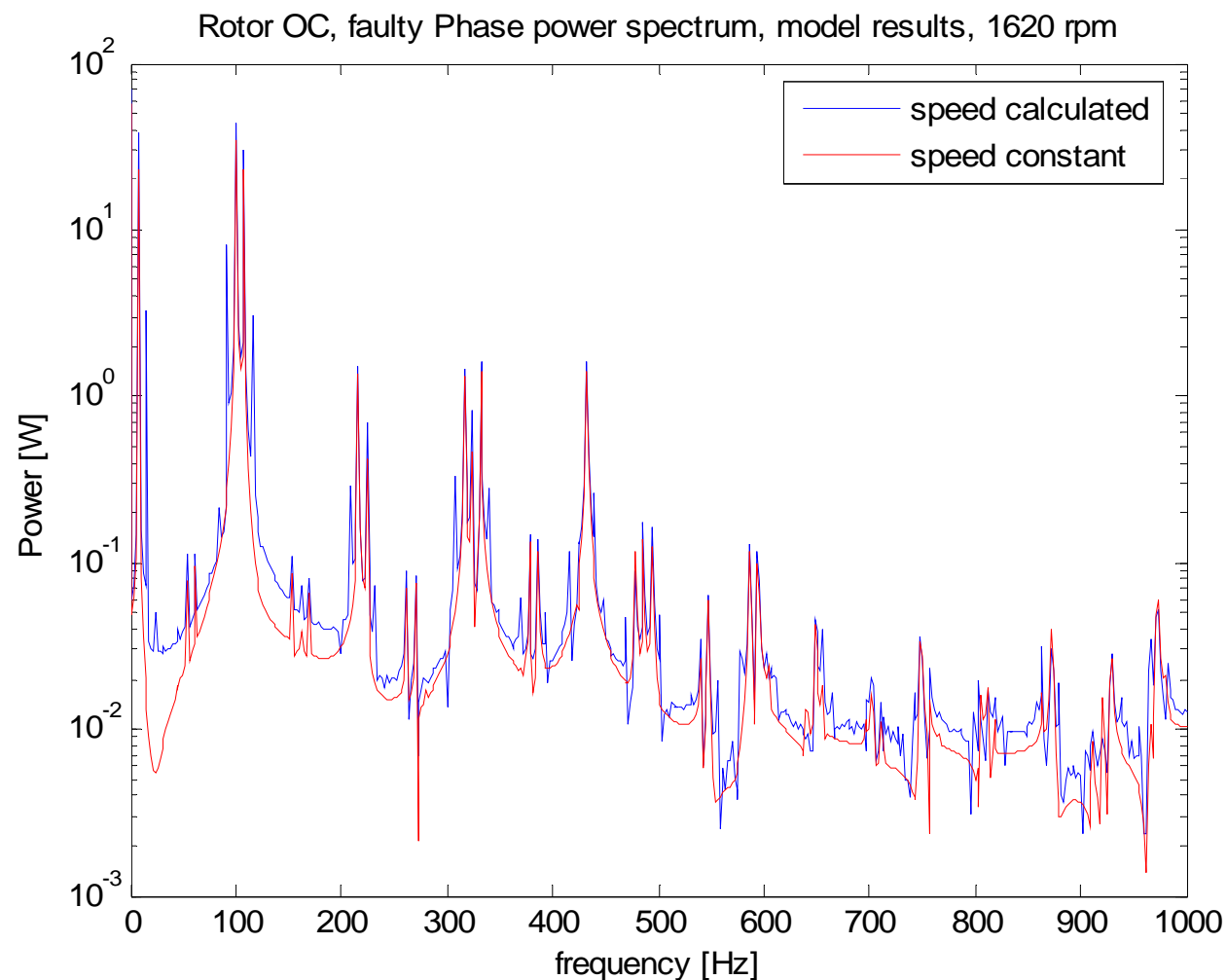
# The effect of the method of speed determination on model results, Current spectrum (ideal voltage supply assumed, Rotor OC)



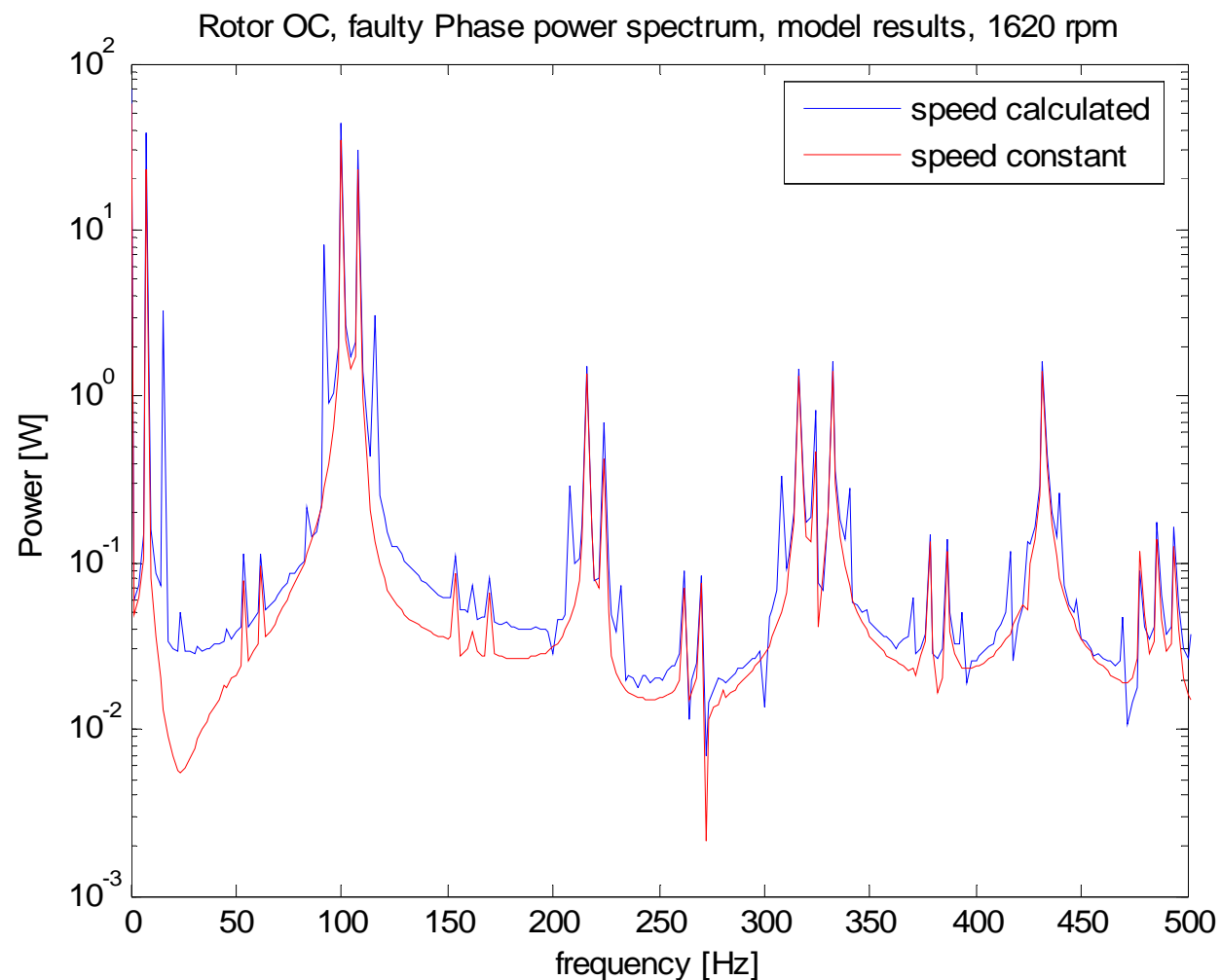
# The effect of the method of speed determination on model results, Current spectrum (ideal voltage supply assumed, Rotor OC)



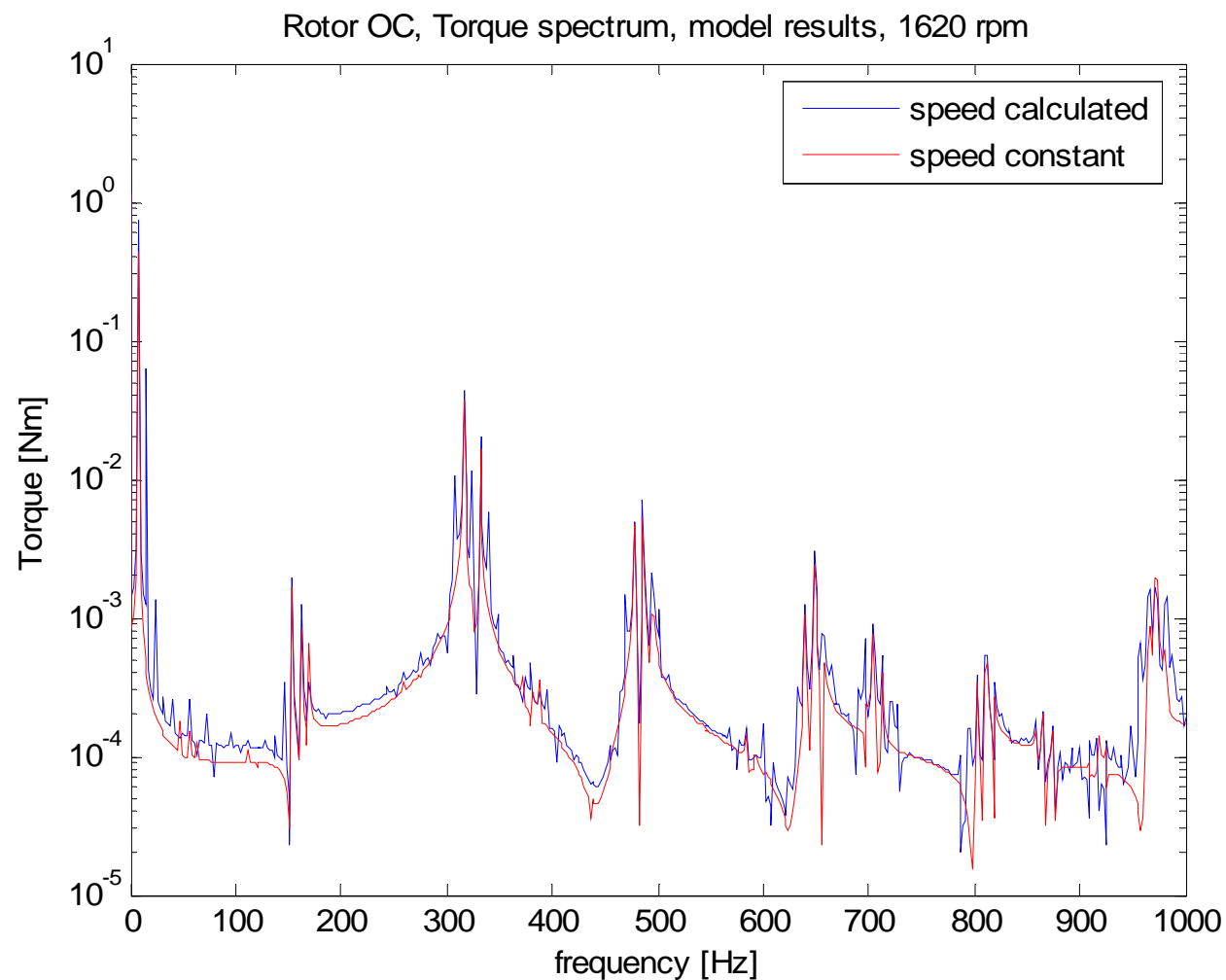
# The effect of the method of speed determination on model results, Power spectrum (ideal voltage supply assumed, Rotor OC)



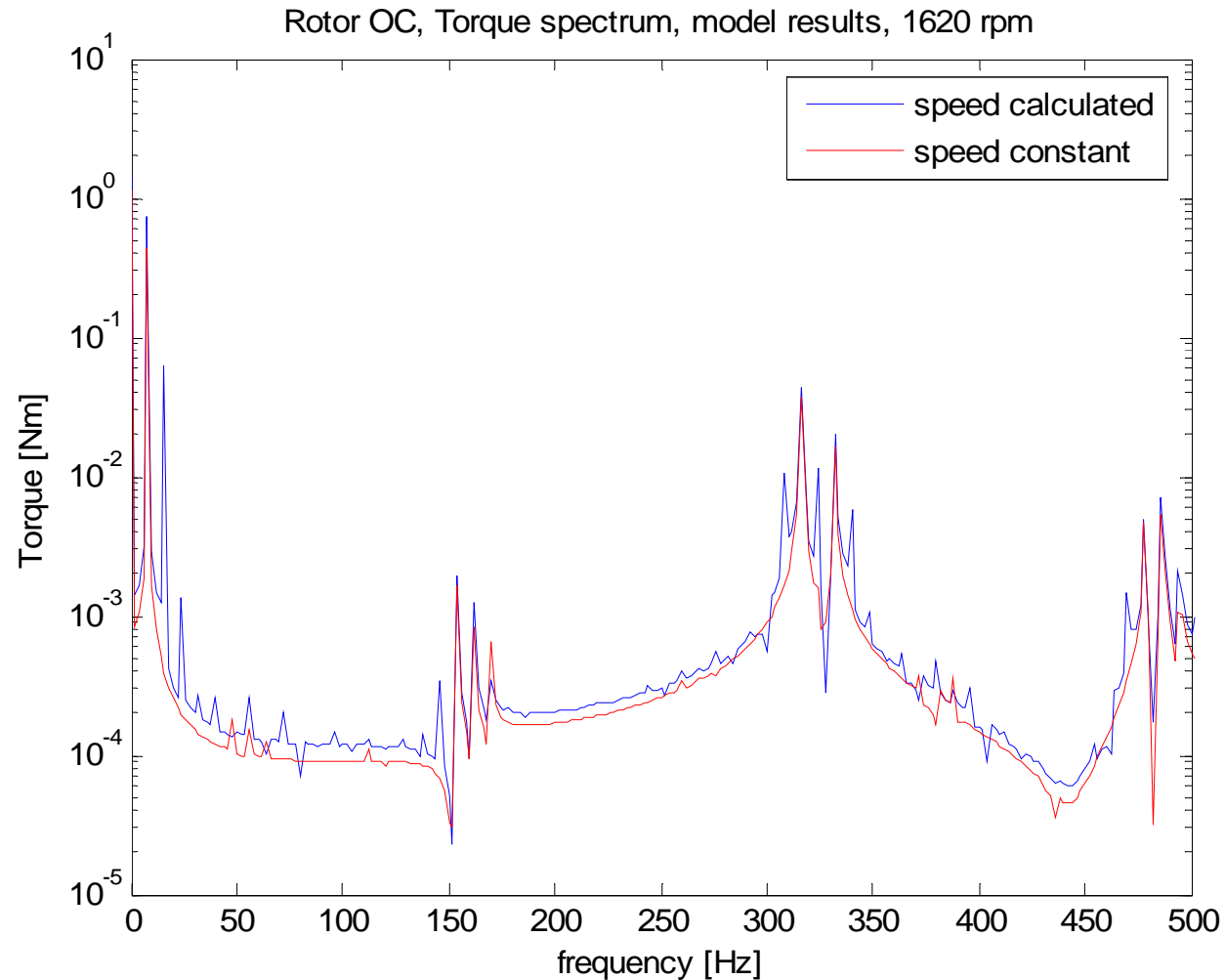
# The effect of the method of speed determination on model results, Power spectrum (ideal voltage supply assumed, Rotor OC)



# The effect of the method of speed determination on model results, Torque spectrum (ideal voltage supply assumed, Rotor OC)

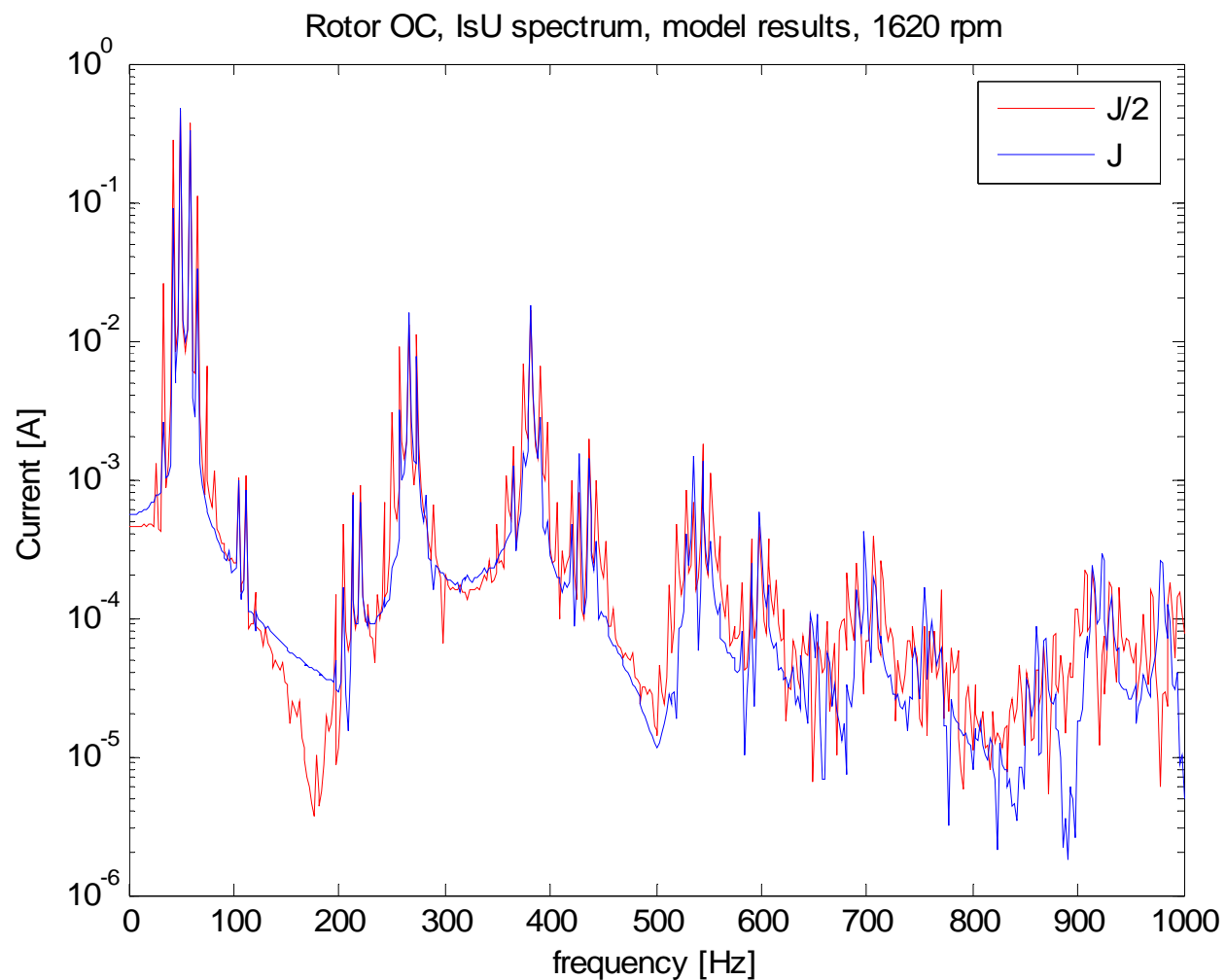


# The effect of the method of speed determination on model results, Torque spectrum (ideal voltage supply assumed, Rotor OC)



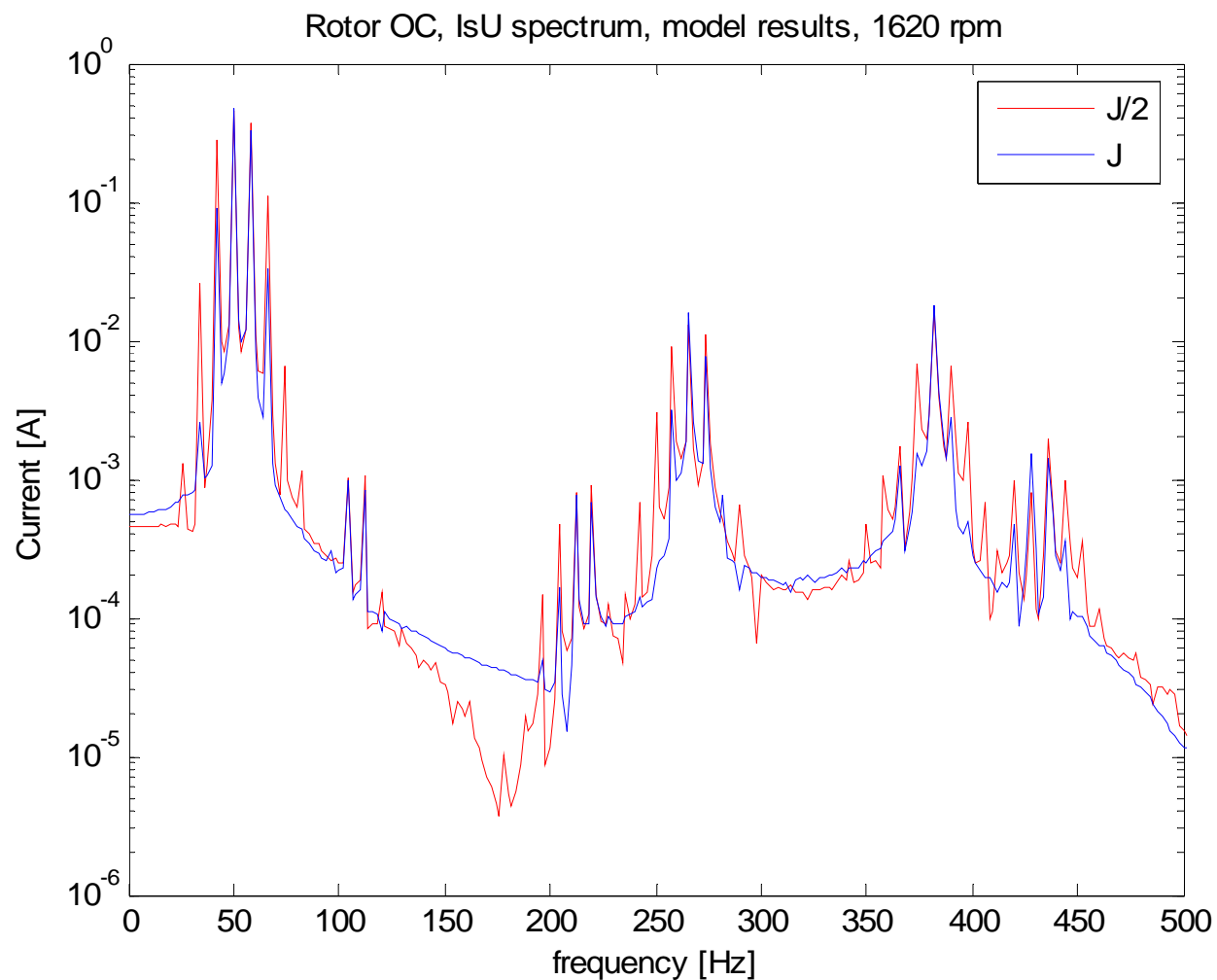
# The effect of inertia value on model results, Current spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



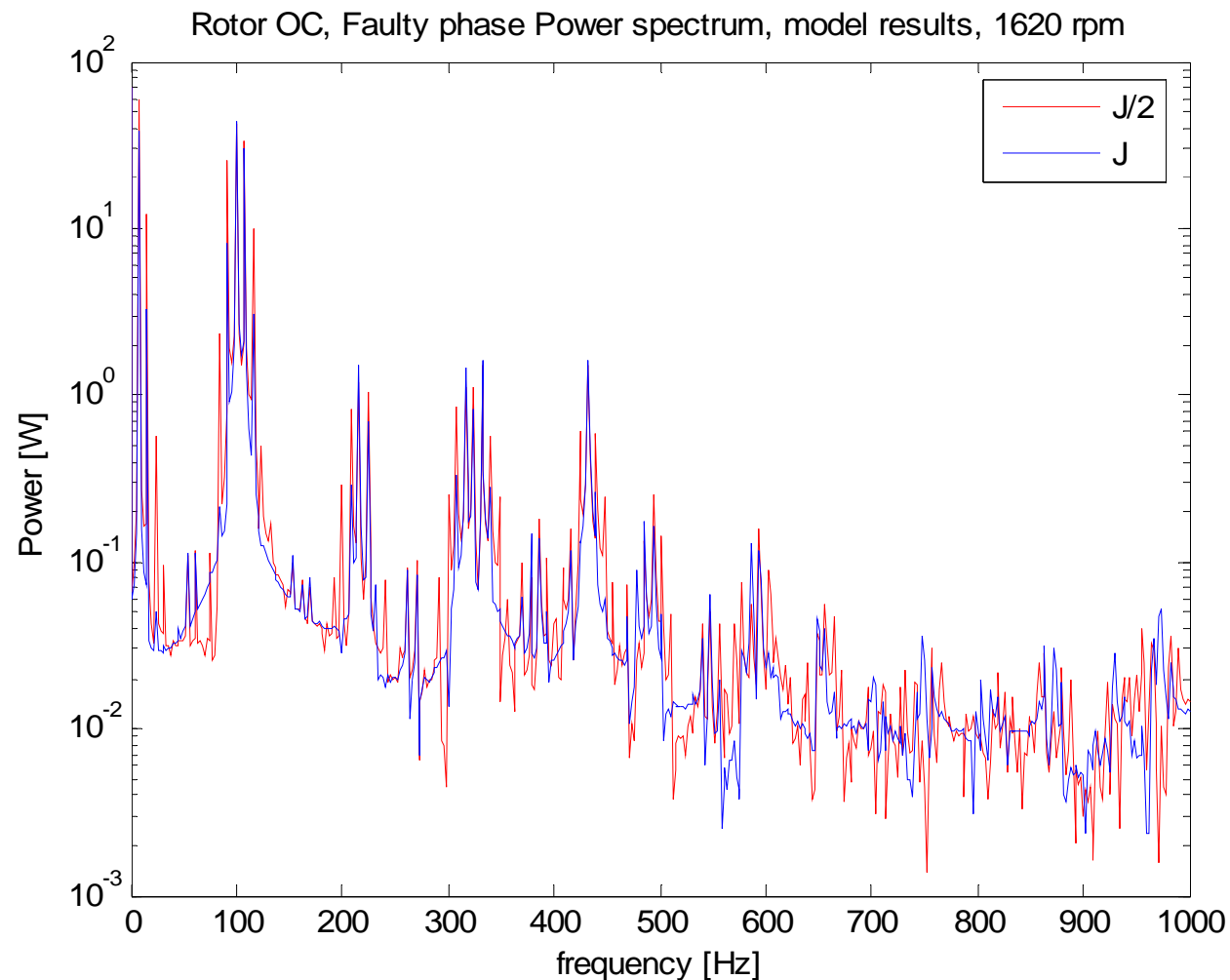
# The effect of inertia value on model results, Current spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



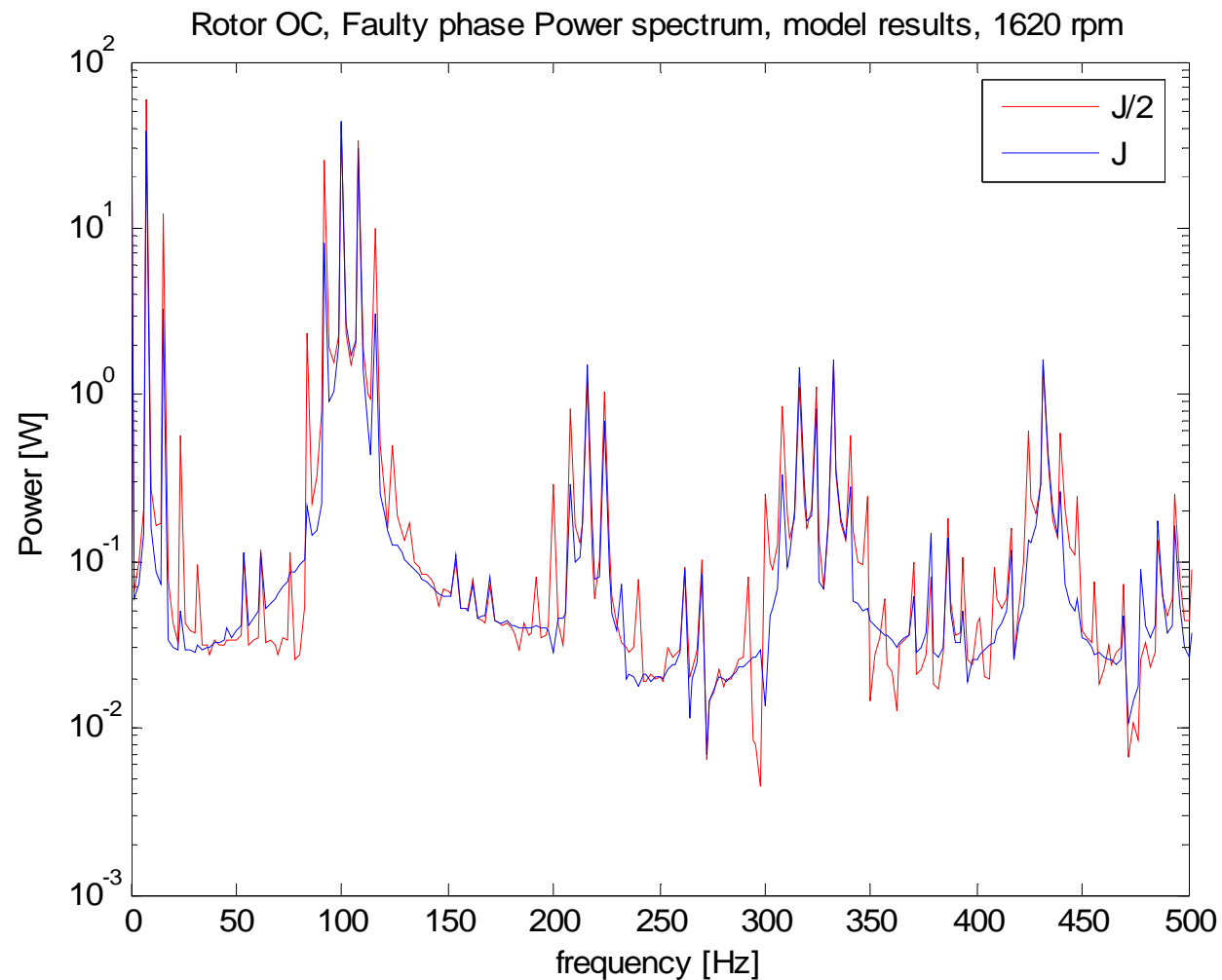
# The effect of inertia value on model results, Power spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



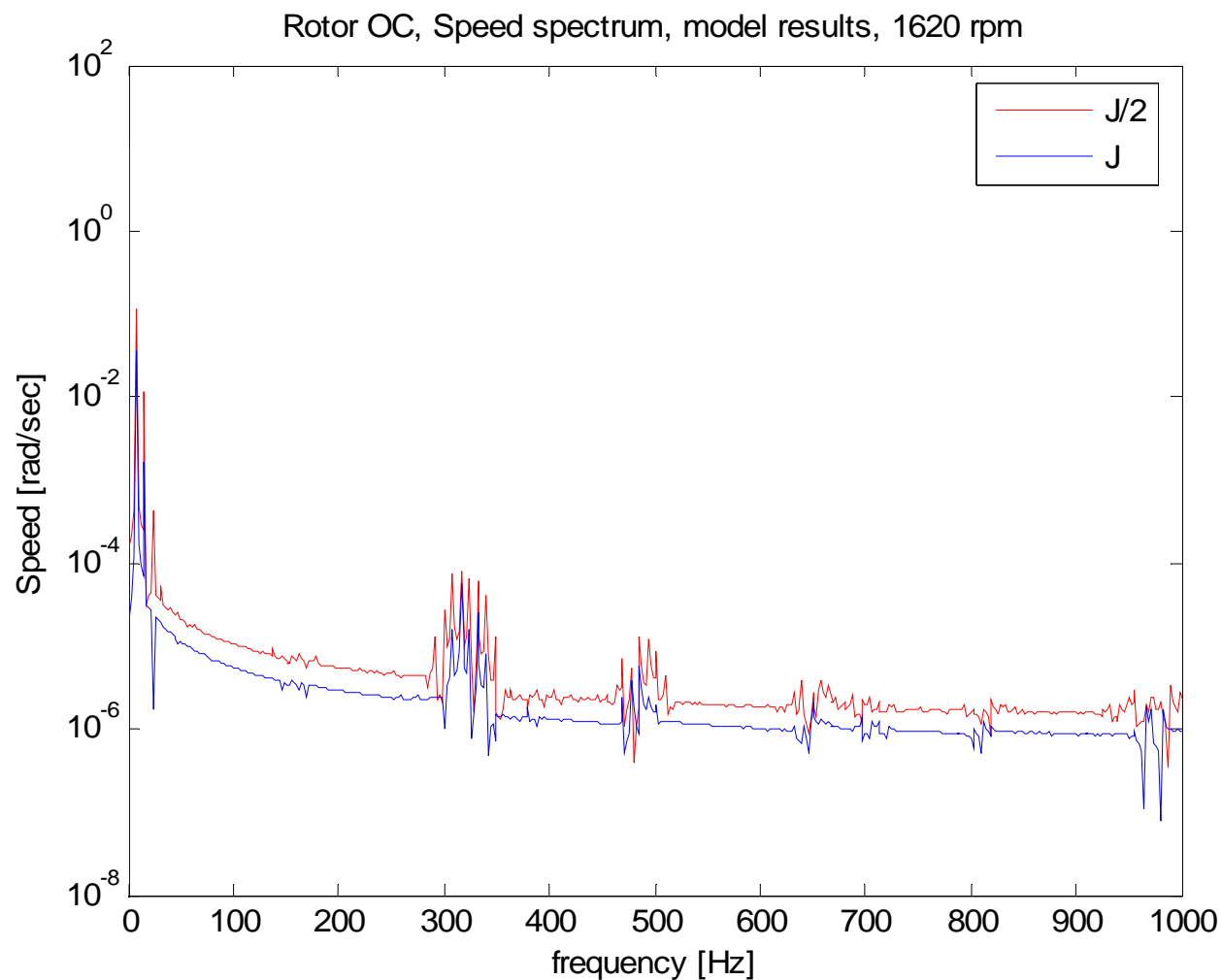
# The effect of inertia value on model results, Power spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



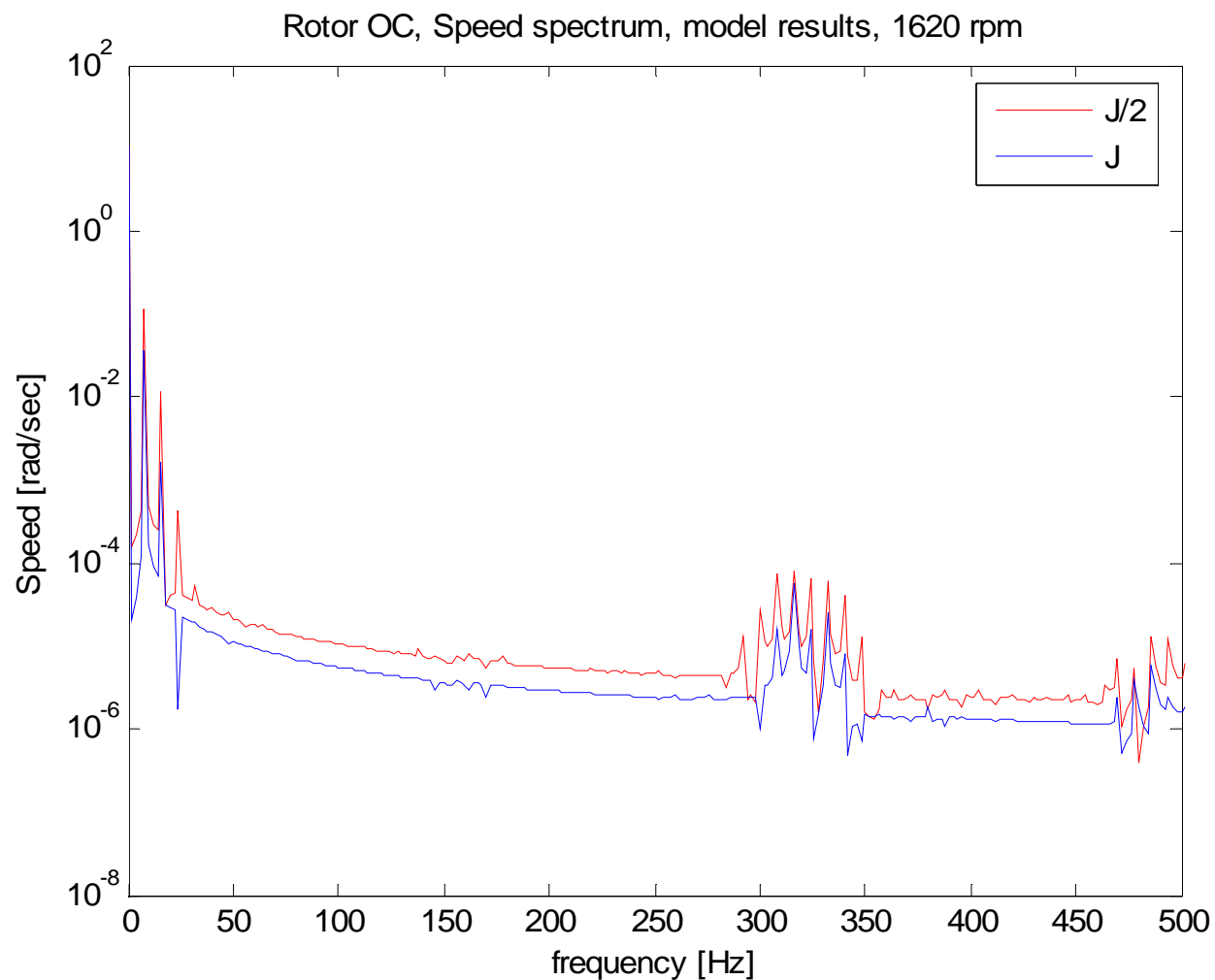
# The effect of inertia value on model results, Speed spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



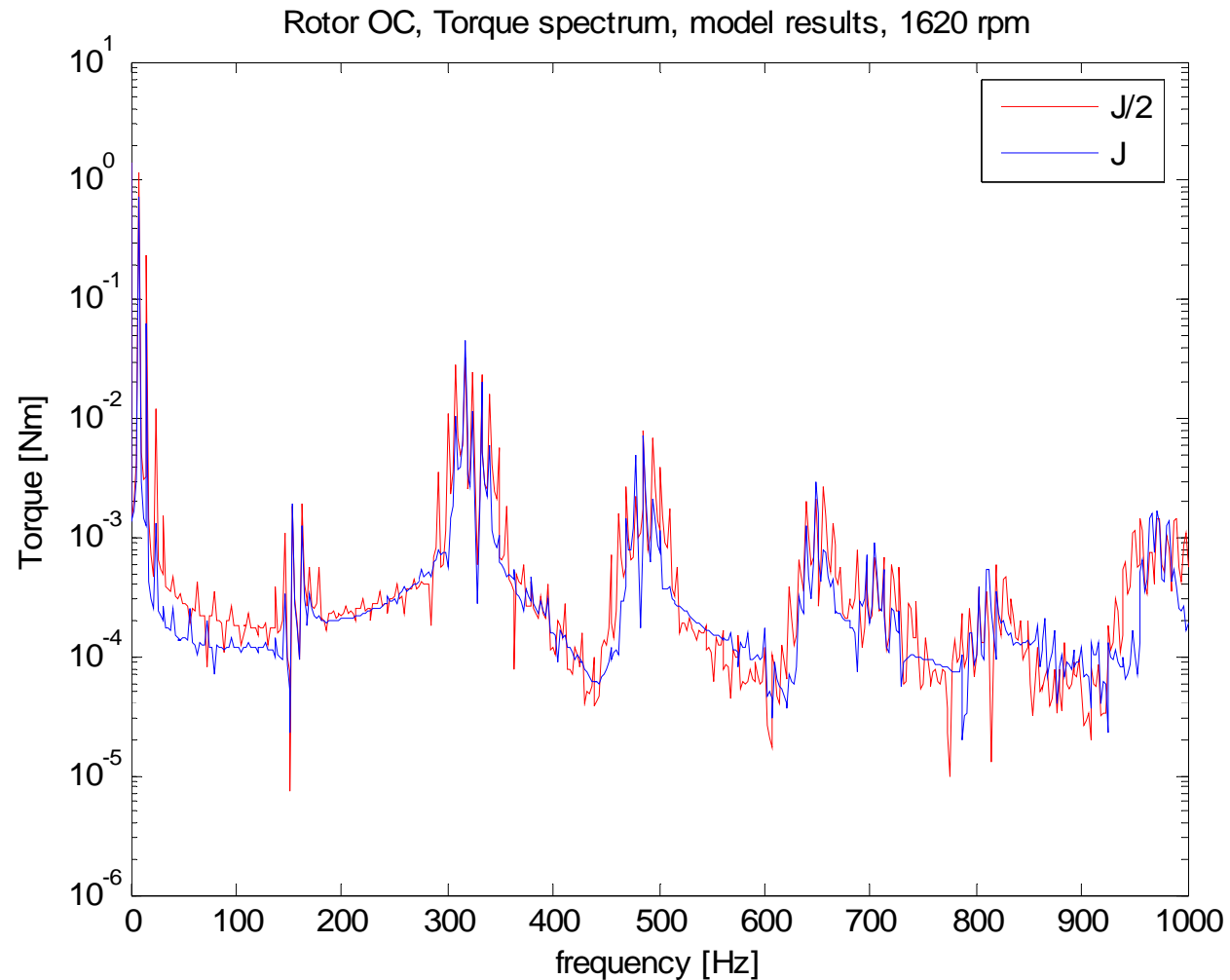
# The effect of inertia value on model results, Speed spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)

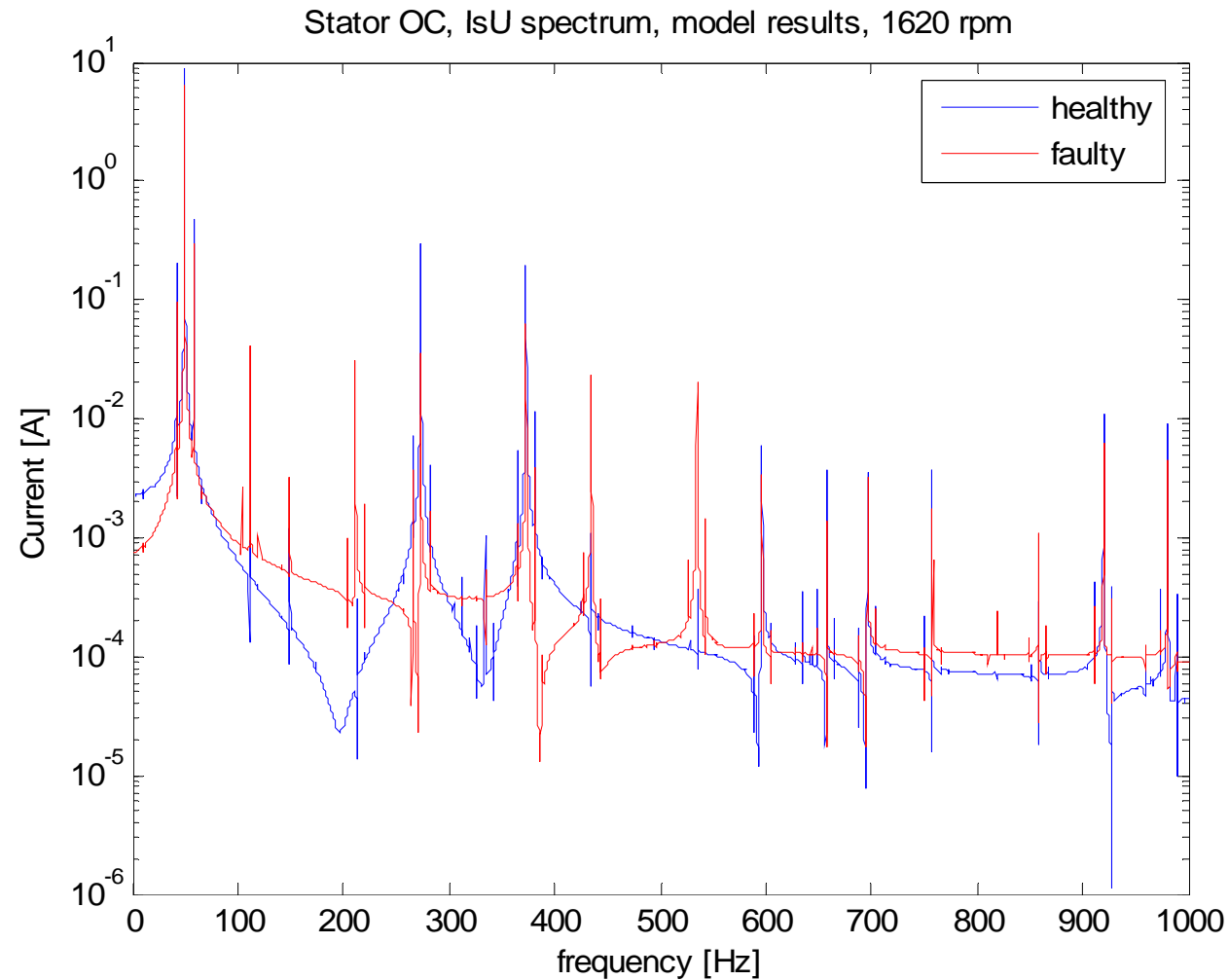


# The effect of inertia value on model results, Torque spectrum

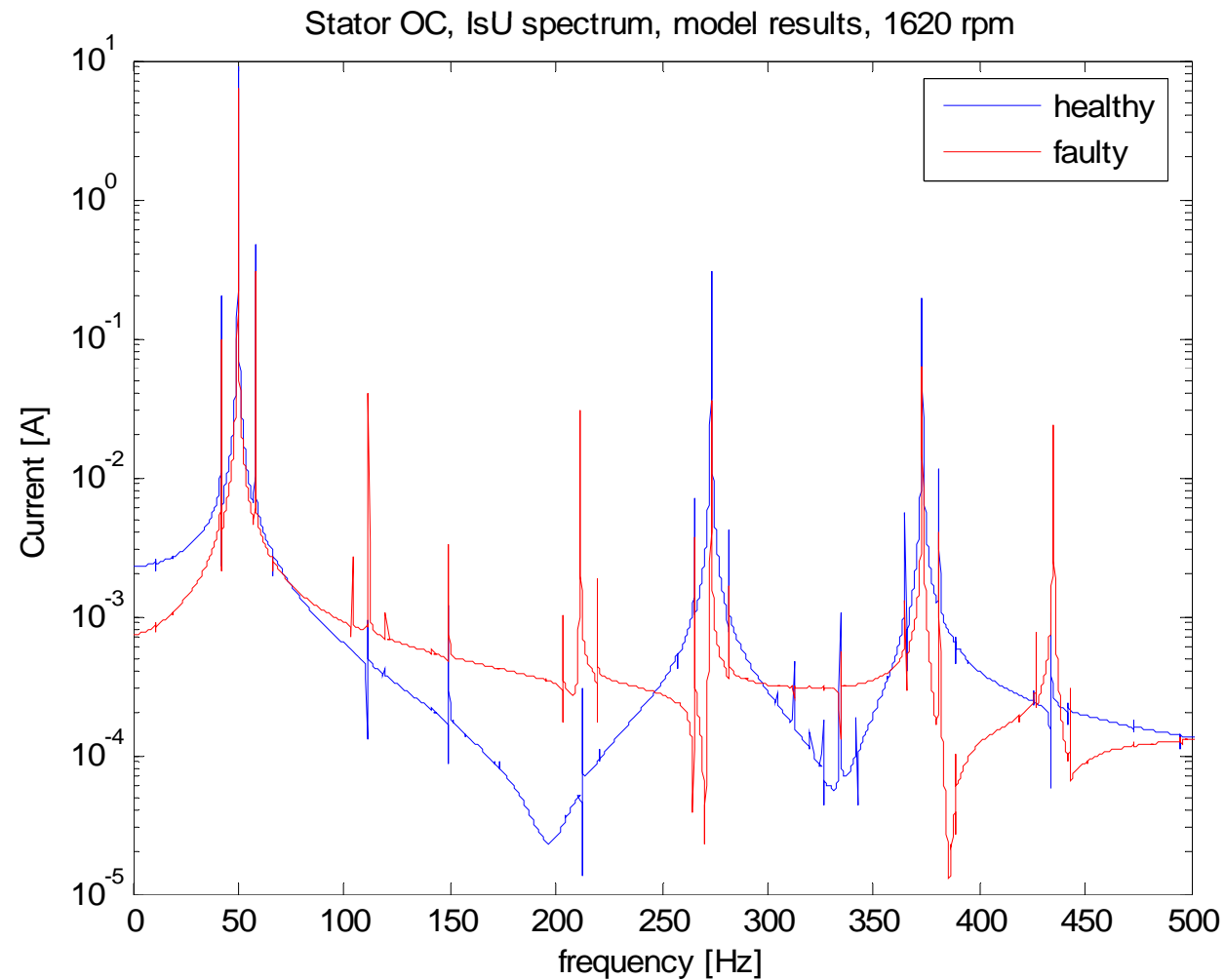
(ideal voltage supply assumed, Rotor OC, speed calculated)



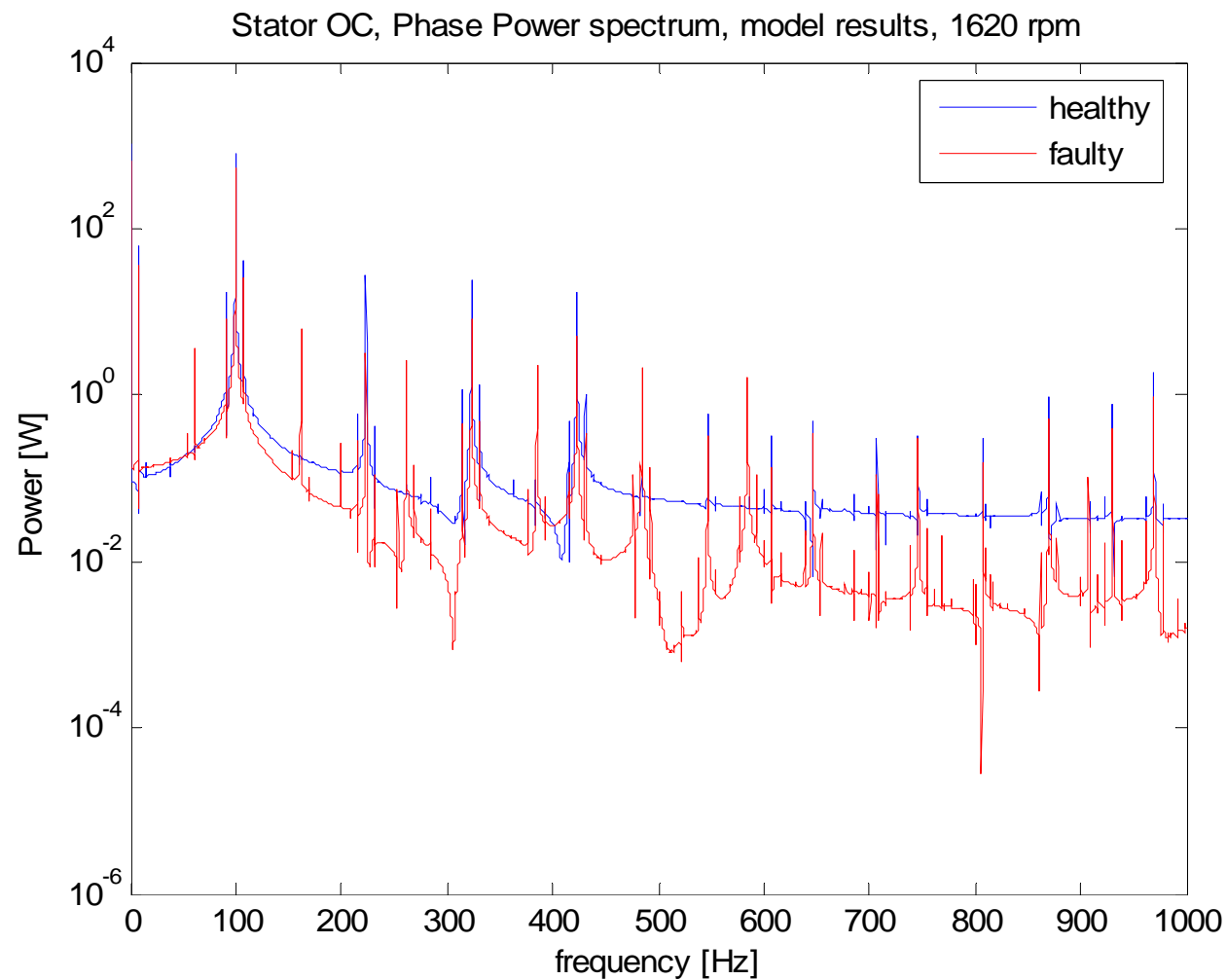
# The effects of a stator OC fault, Current spectrum (voltage supply asymmetry modelled, speed calculated)



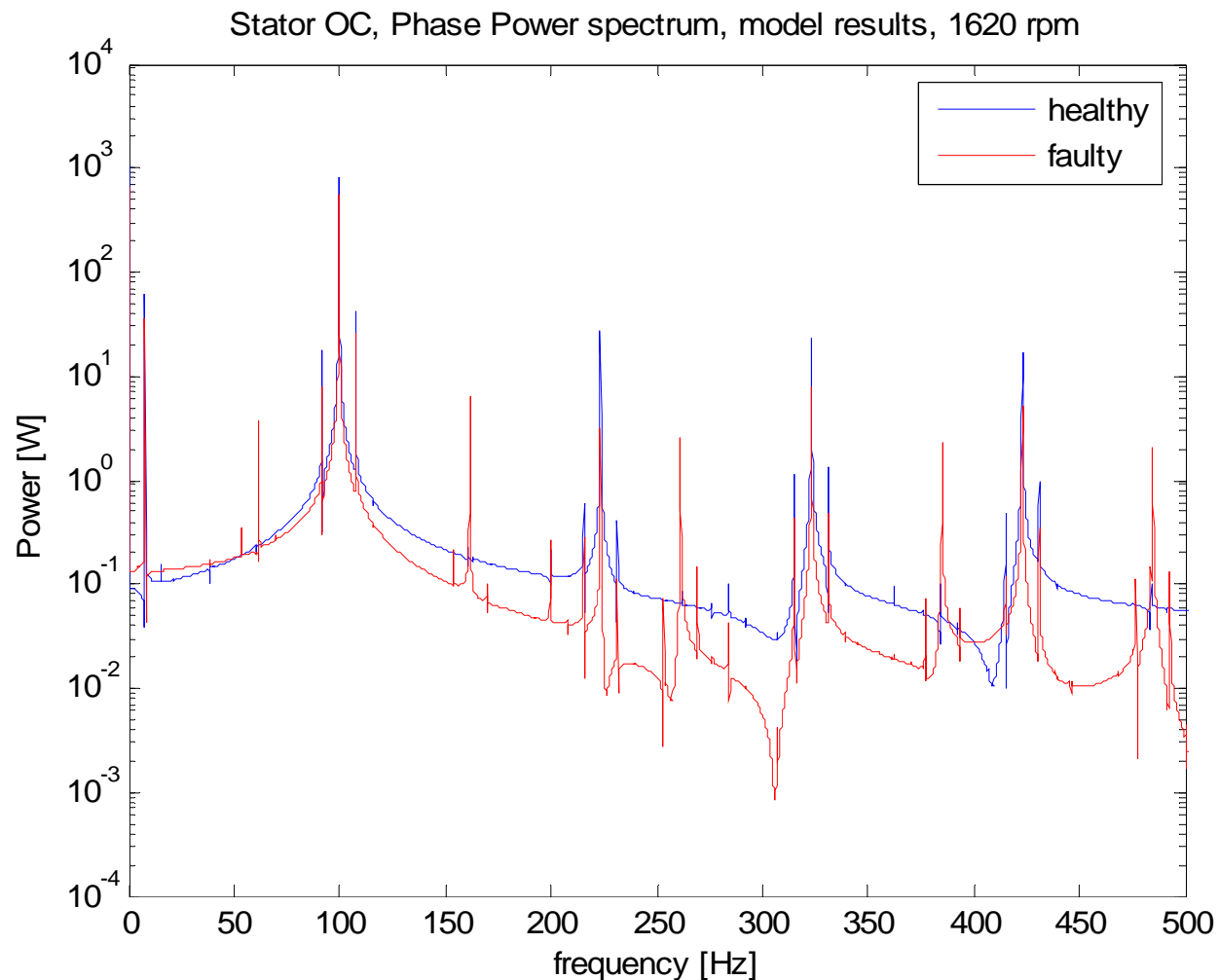
# The effects of a stator OC fault, Current spectrum (voltage supply asymmetry modelled, speed calculated)



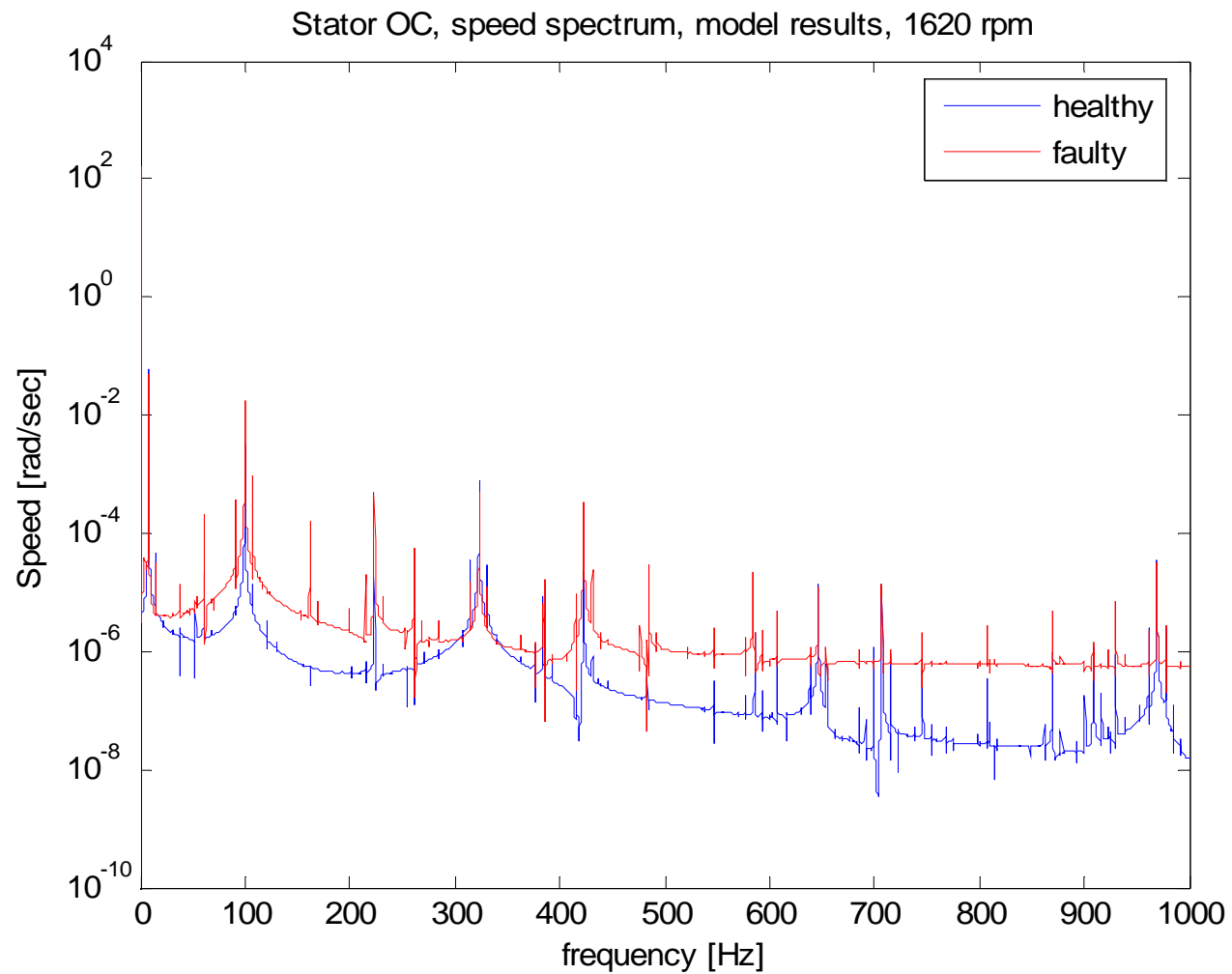
# The effects of a stator OC fault, Power spectrum (voltage supply asymmetry modelled, speed calculated)



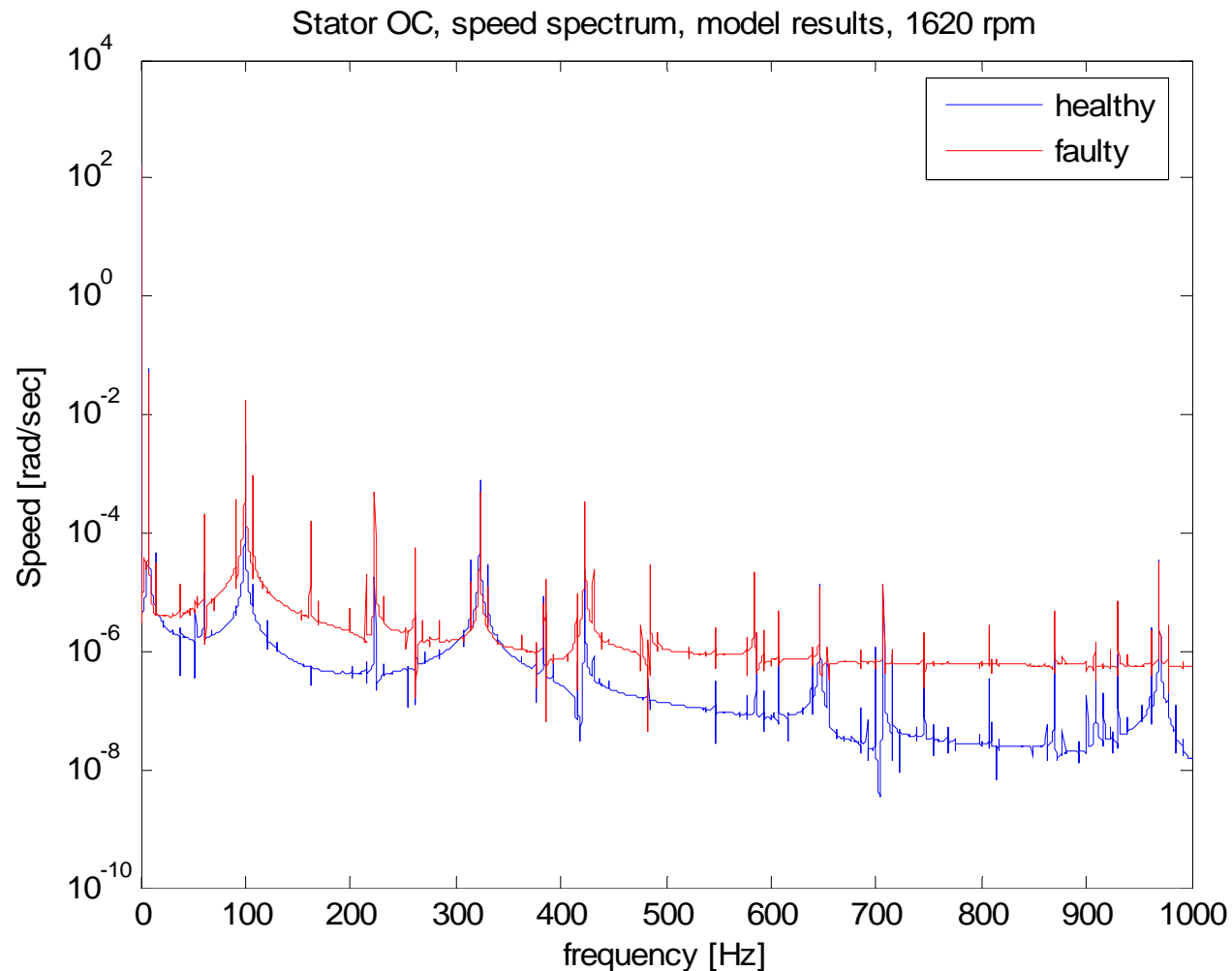
# The effects of a stator OC fault, Power spectrum (voltage supply asymmetry modelled, speed calculated)



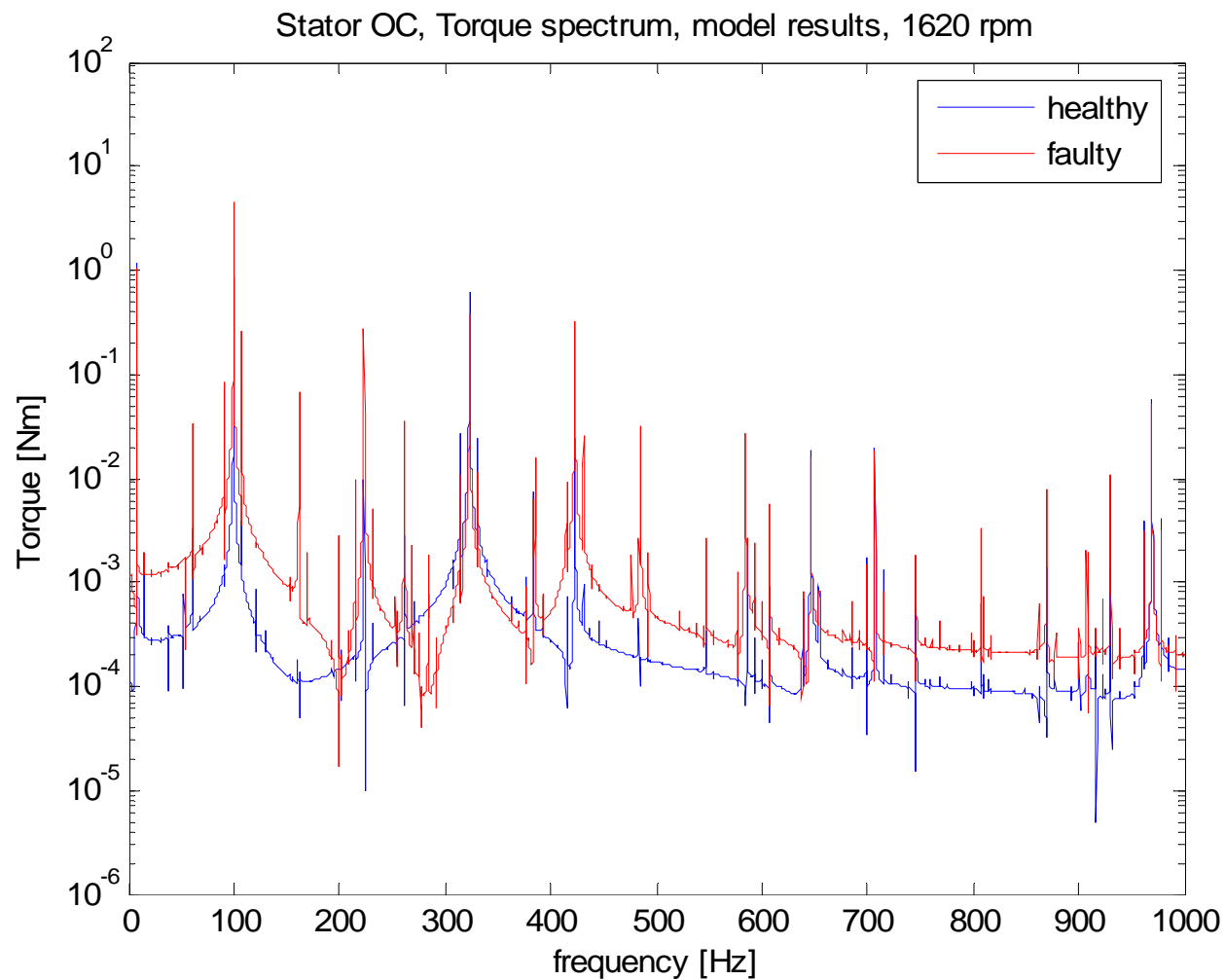
# The effects of a stator OC fault, Speed spectrum (voltage supply asymmetry modelled, speed calculated)



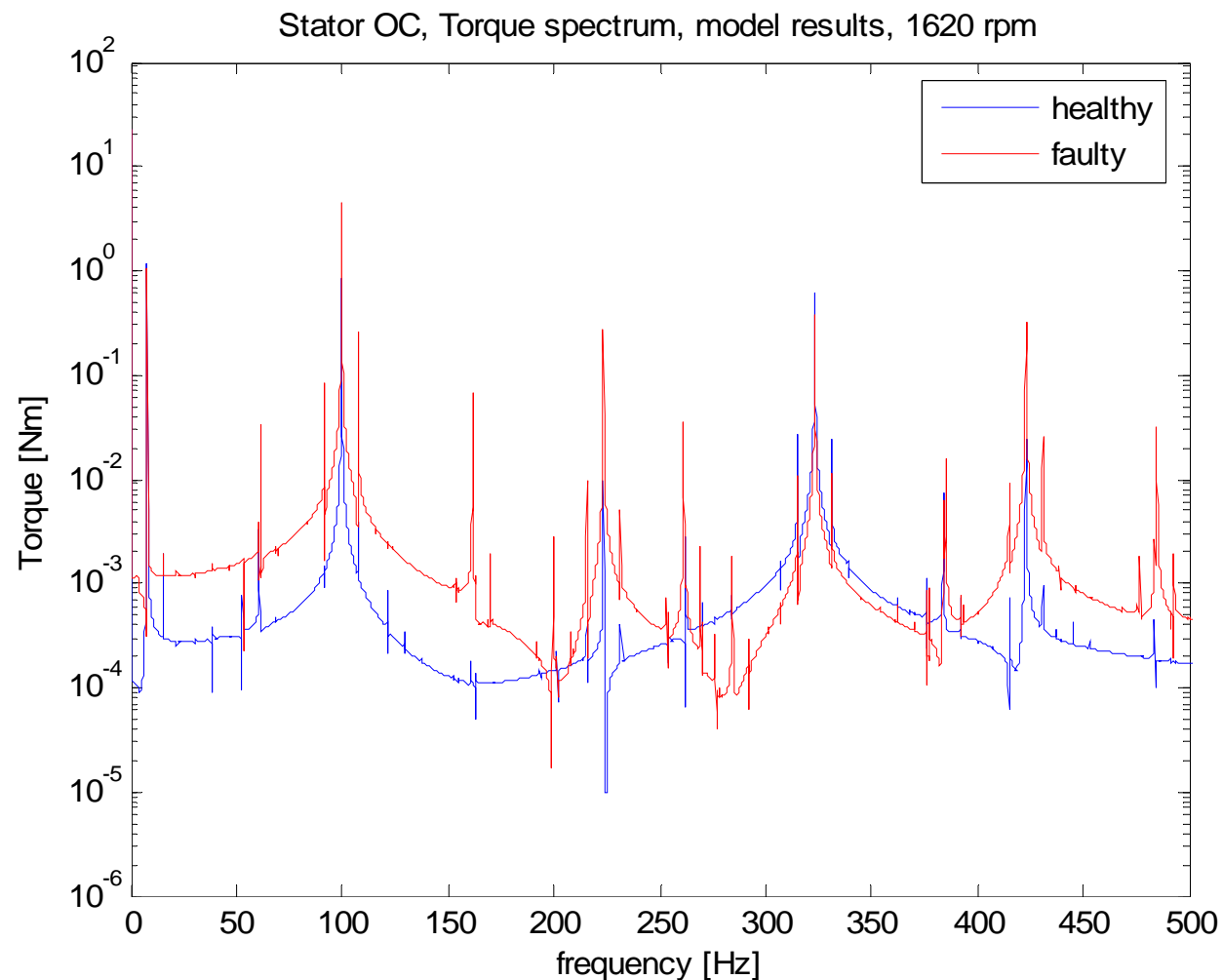
# The effects of a stator OC fault, Speed spectrum (voltage supply asymmetry modelled, speed calculated)



# The effects of a stator OC fault, Torque spectrum (voltage supply asymmetry modelled, speed calculated)

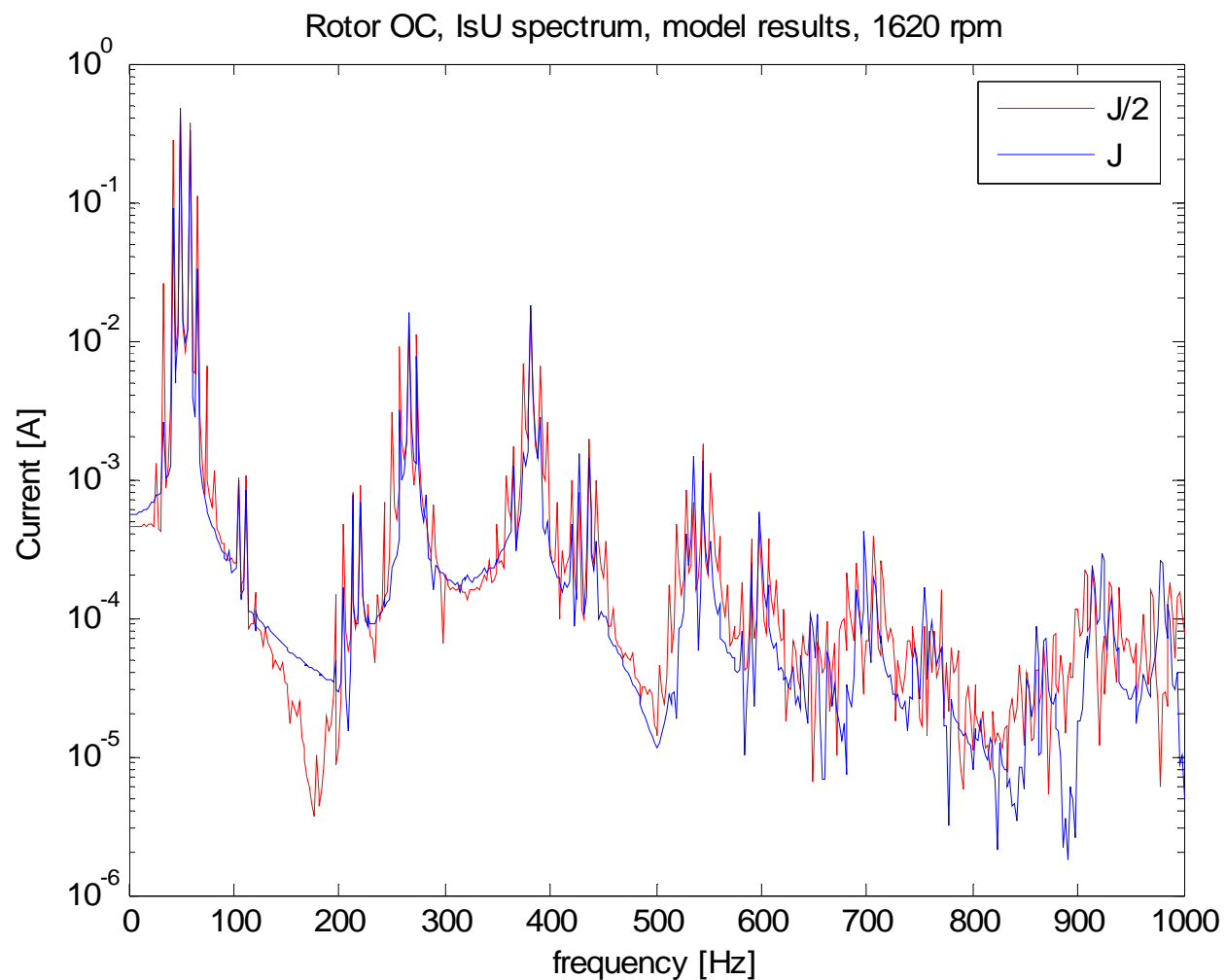


# The effects of a stator OC fault, Torque spectrum (voltage supply asymmetry modelled, speed calculated)



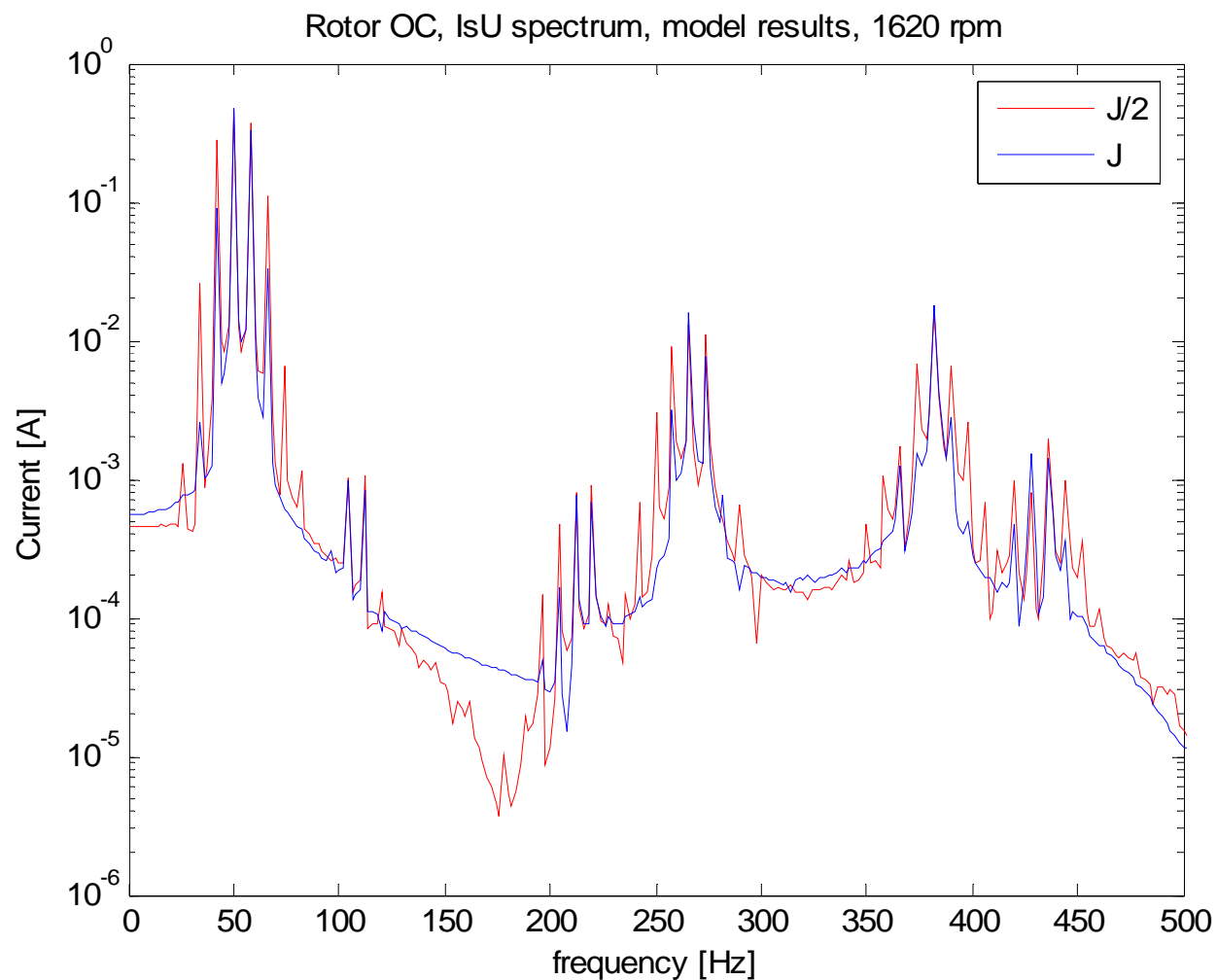
# The effect of inertia value on model results, Current spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



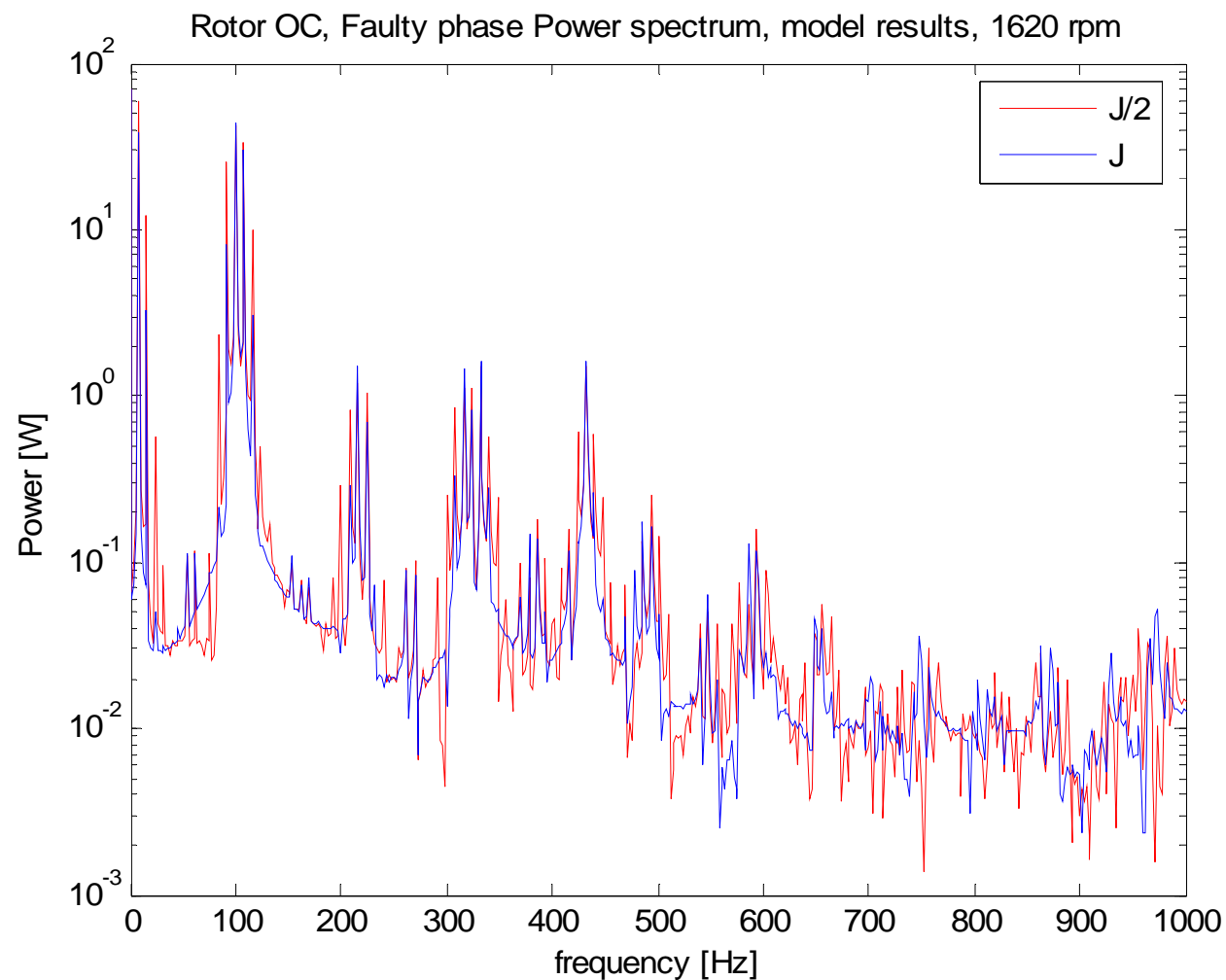
# The effect of inertia value on model results, Current spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



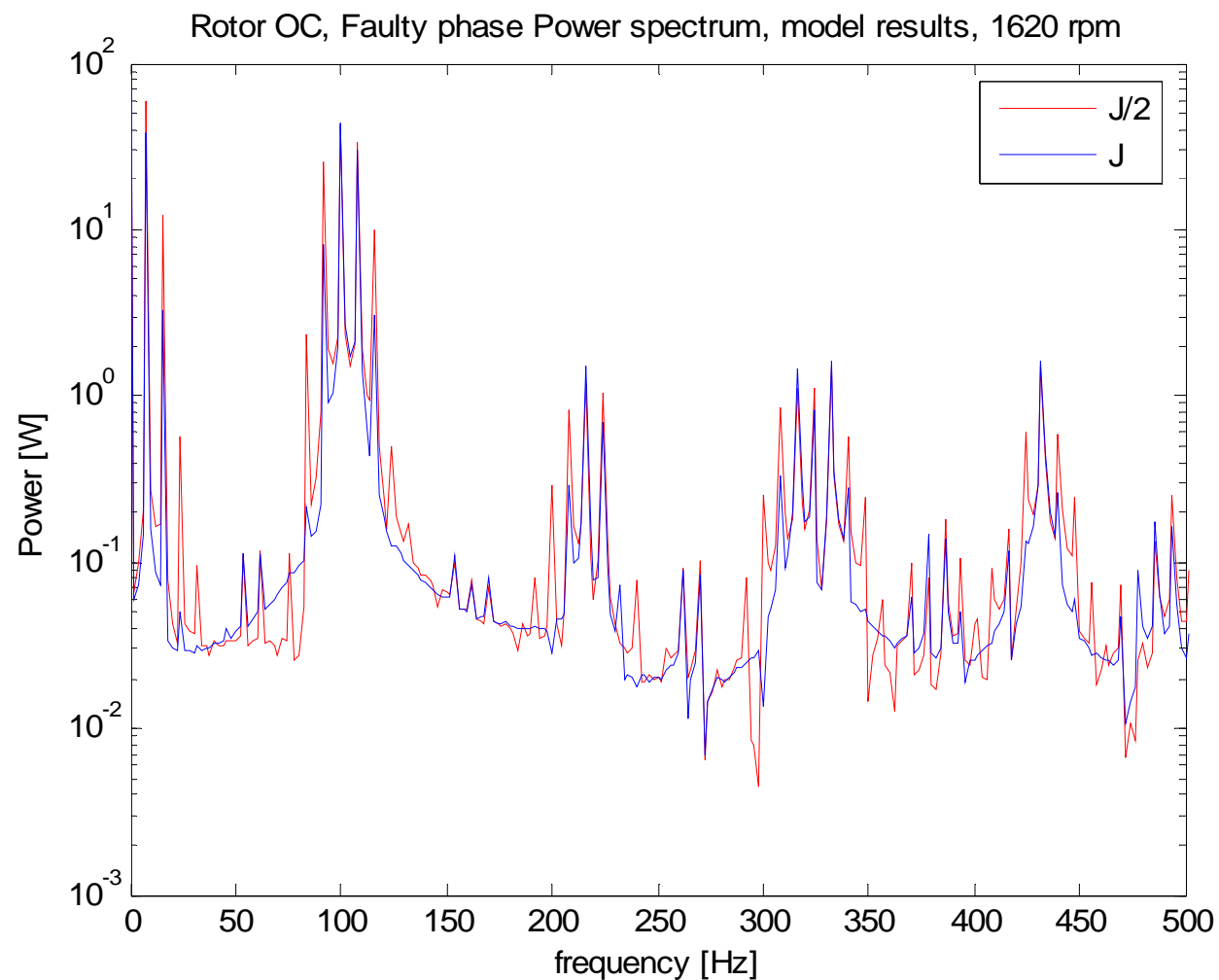
# The effect of inertia value on model results, Power spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



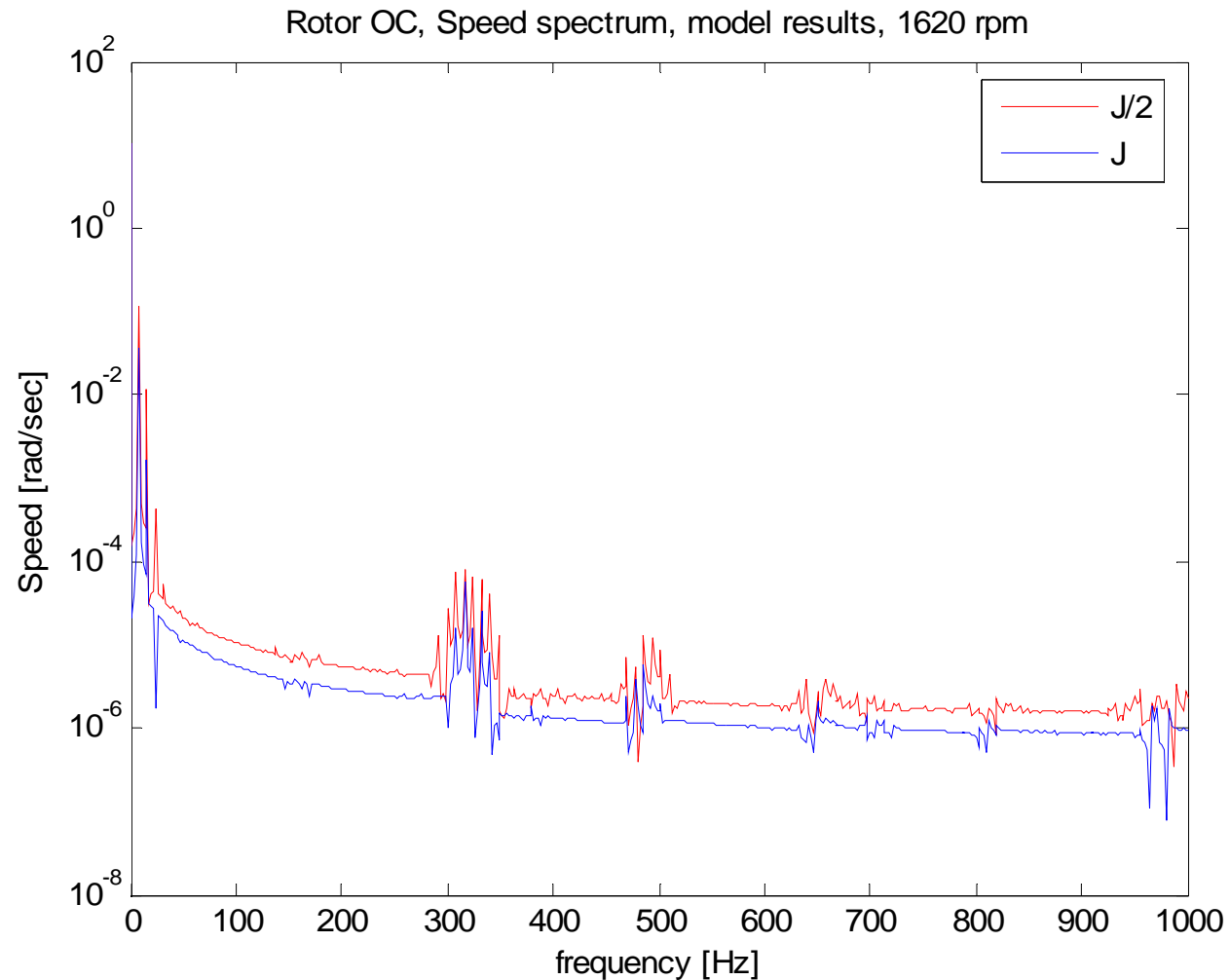
# The effect of inertia value on model results, Power spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



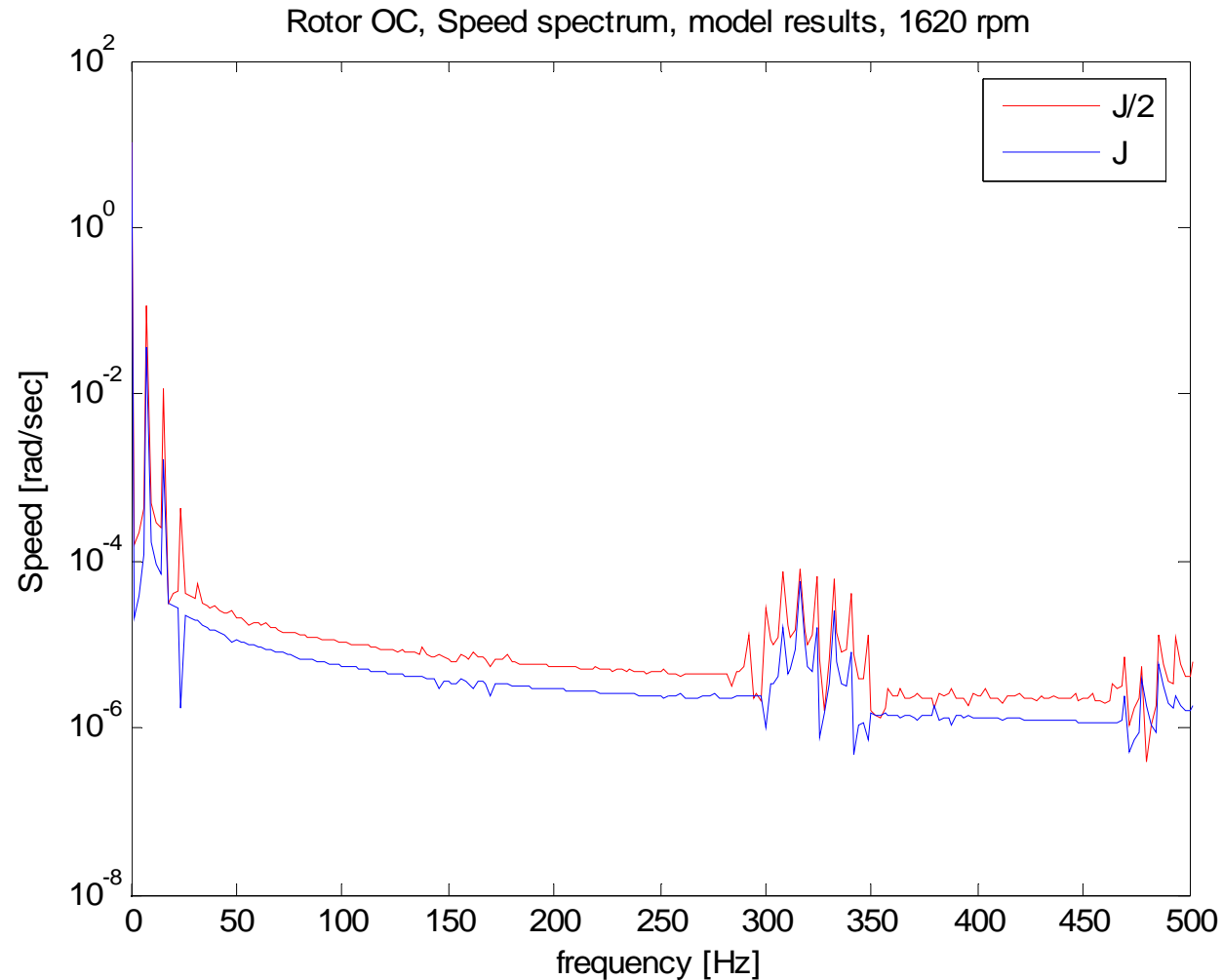
# The effect of inertia value on model results, Speed spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



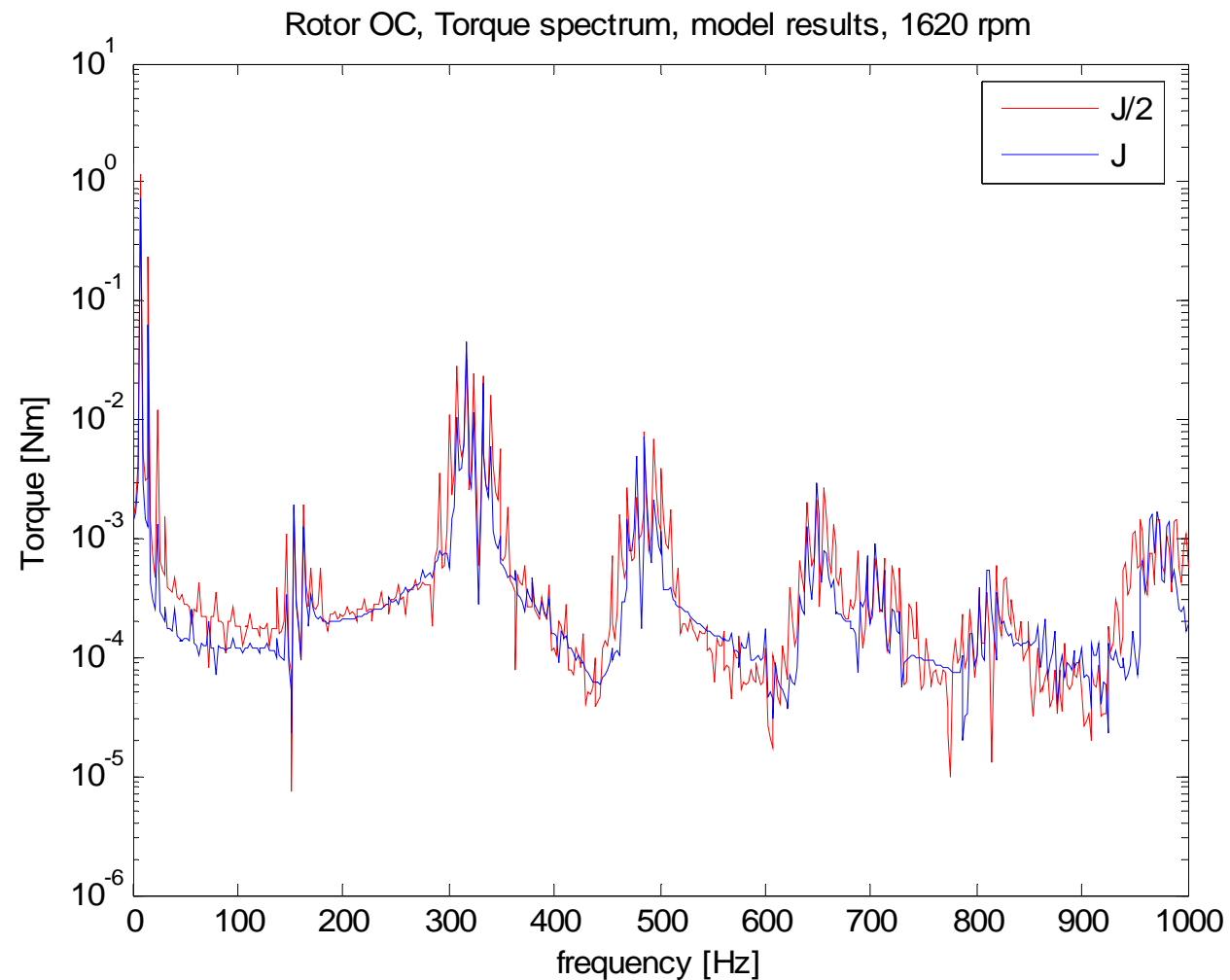
# The effect of inertia value on model results, Speed spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)



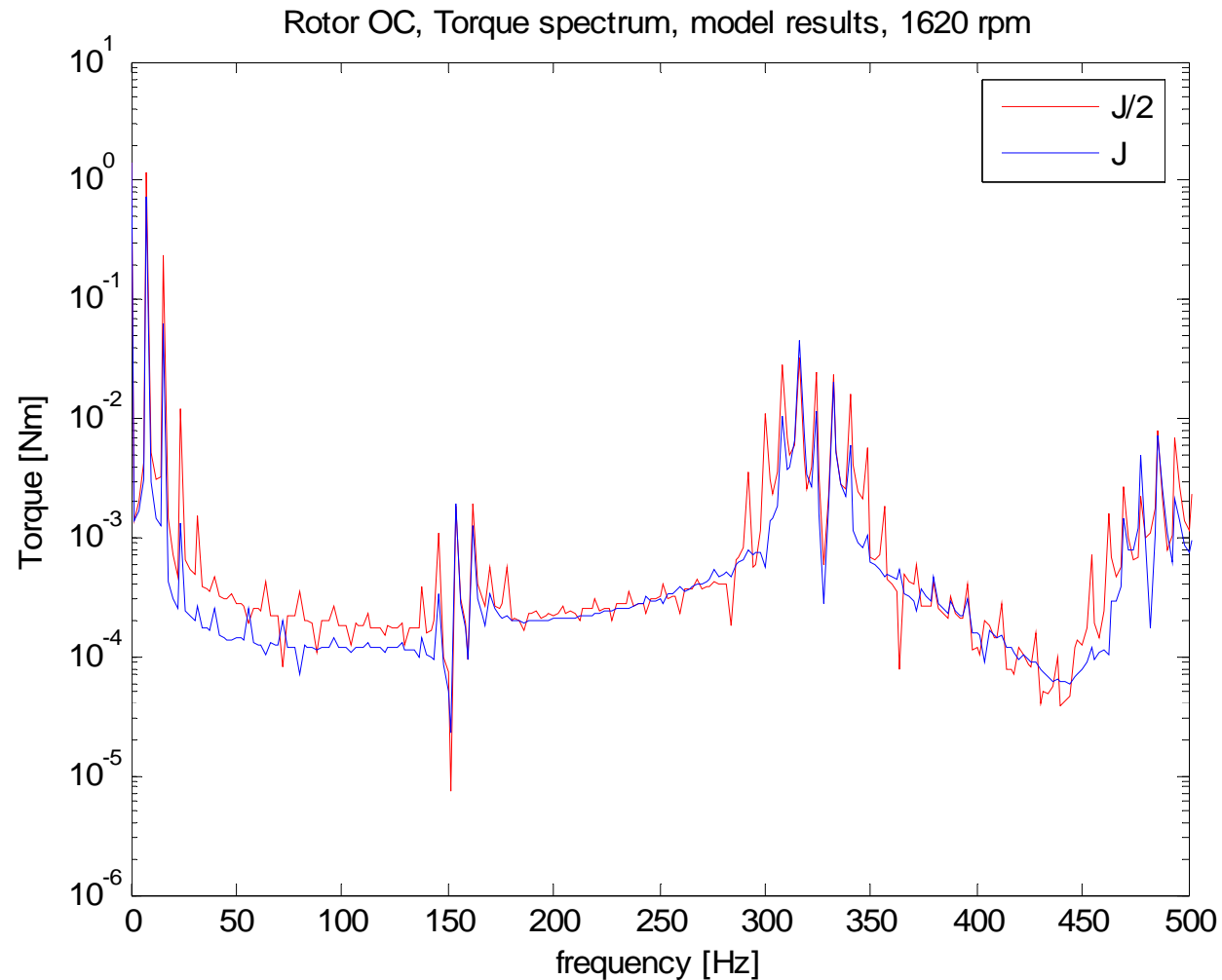
# The effect of inertia value on model results, Torque spectrum

(ideal voltage supply assumed, Rotor OC, speed calculated)

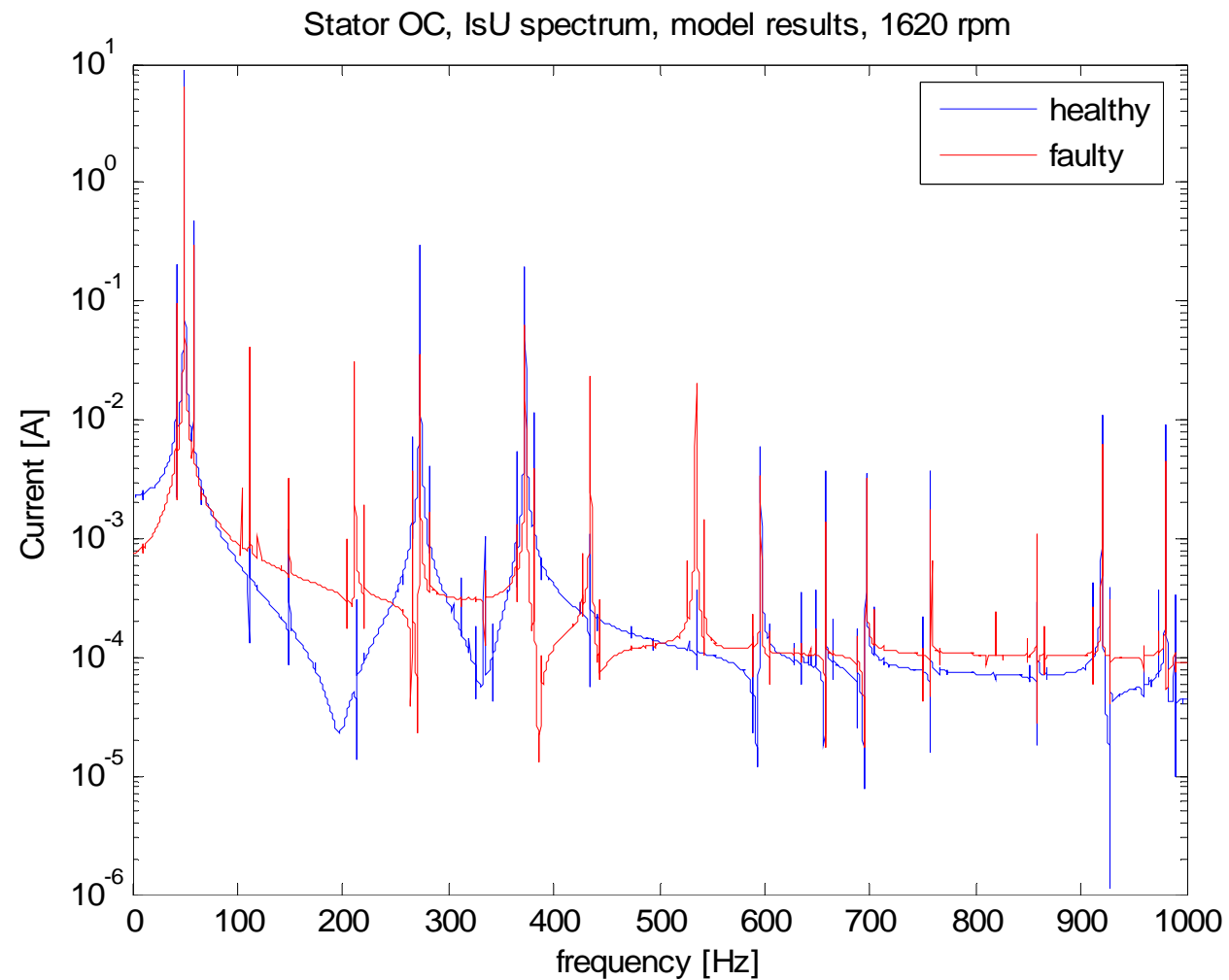


# The effect of inertia value on model results, Torque spectrum

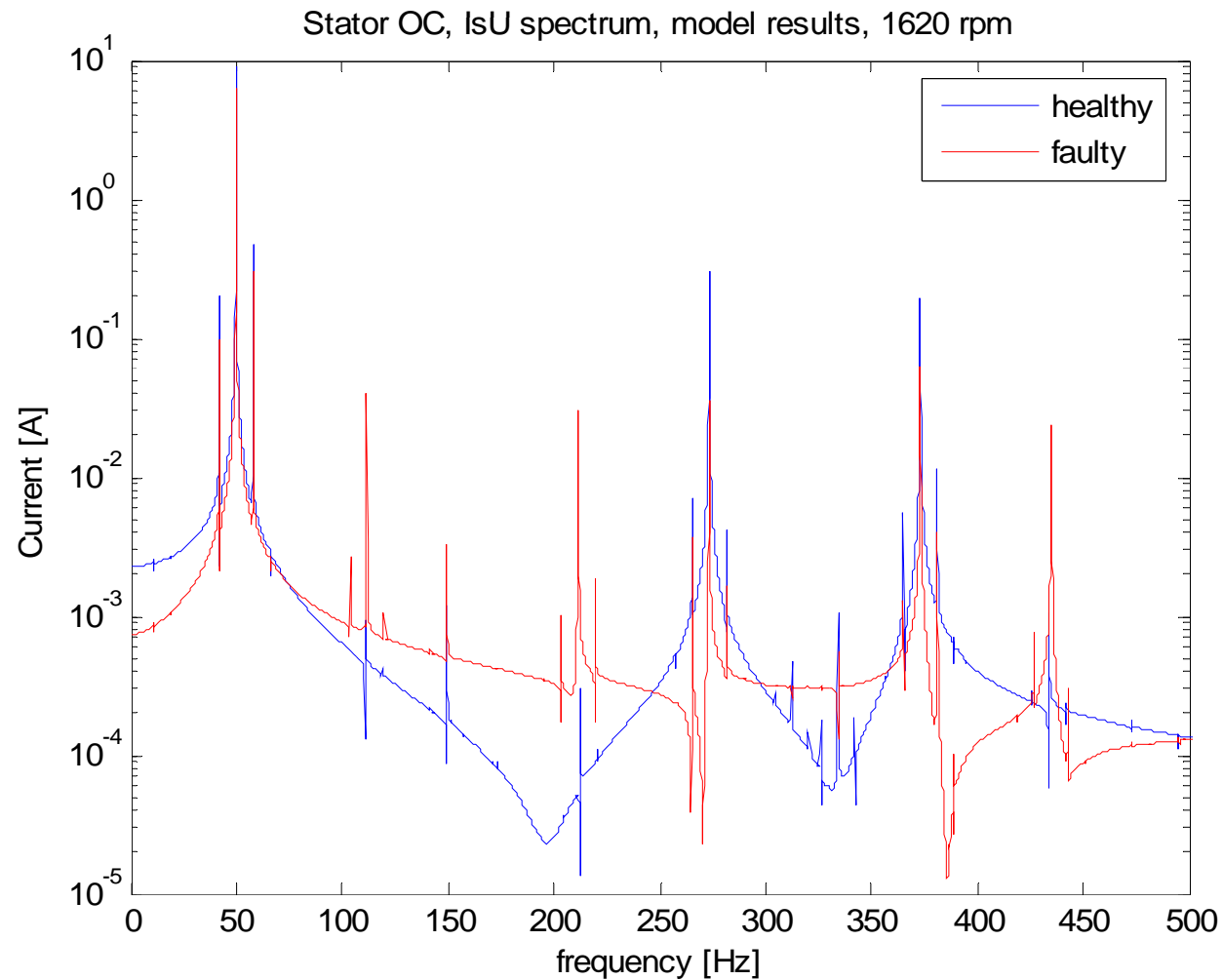
(ideal voltage supply assumed, Rotor OC, speed calculated)



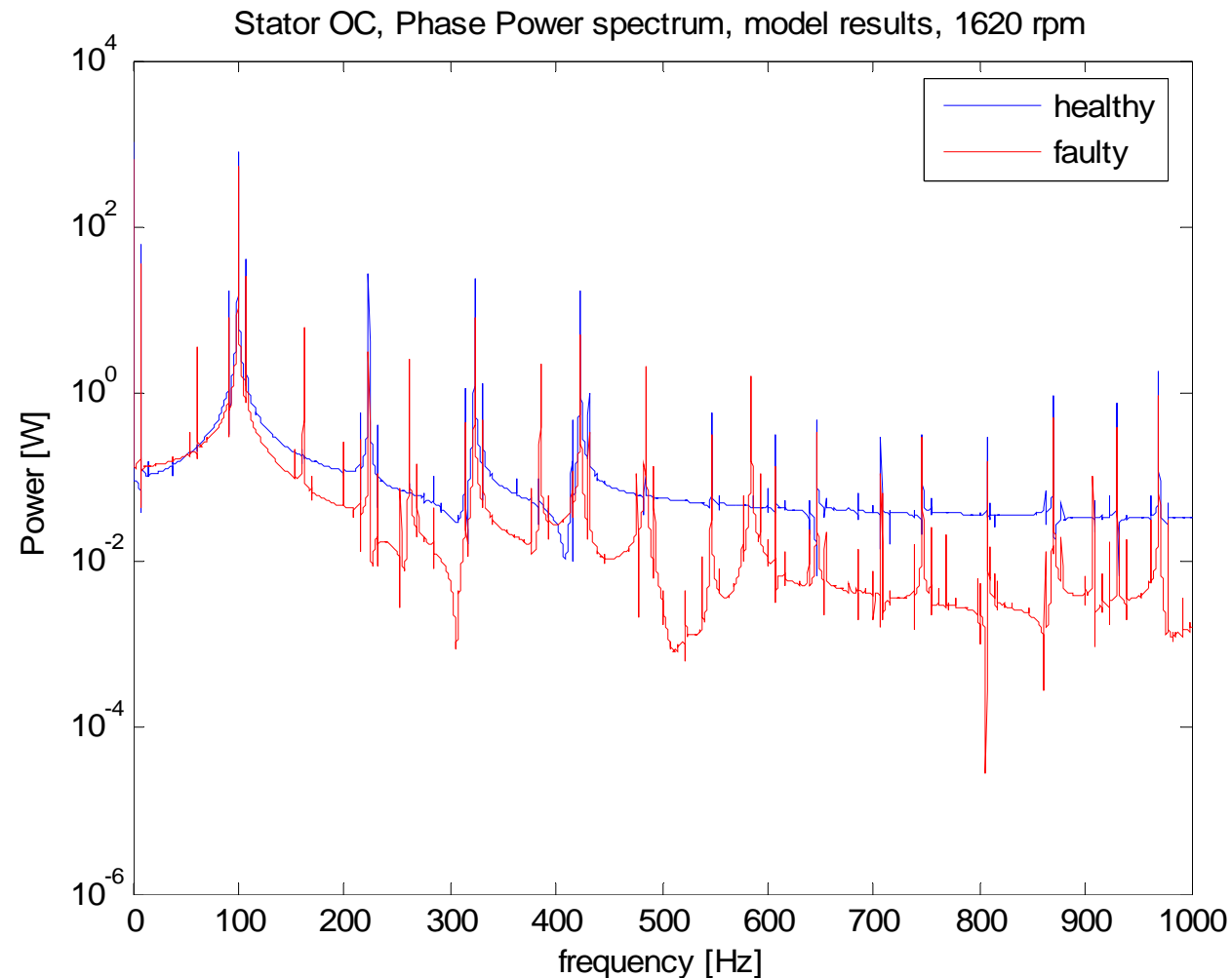
# The effects of a stator OC fault, Current spectrum (voltage supply asymmetry modelled, speed calculated)



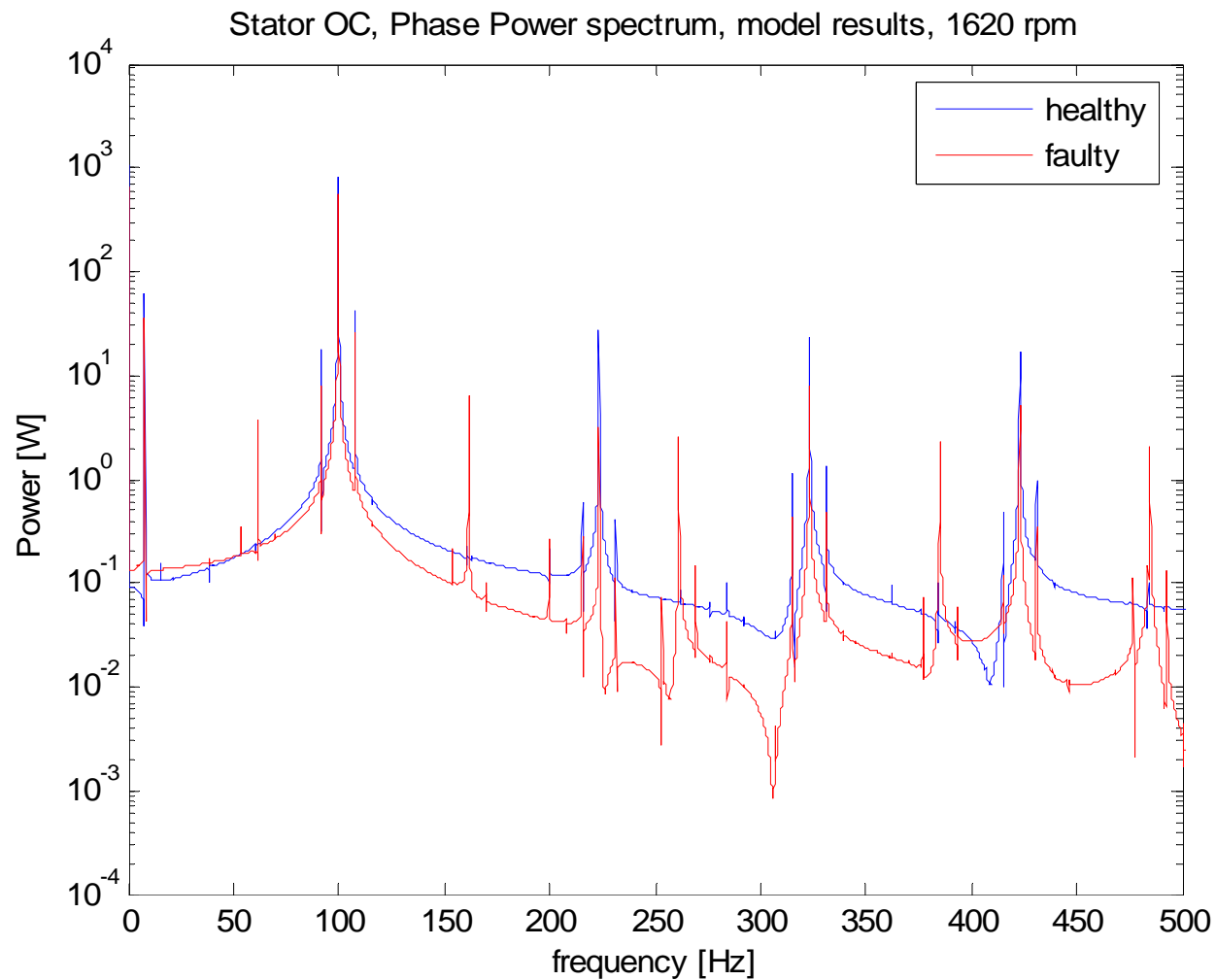
# The effects of a stator OC fault, Current spectrum (voltage supply asymmetry modelled, speed calculated)



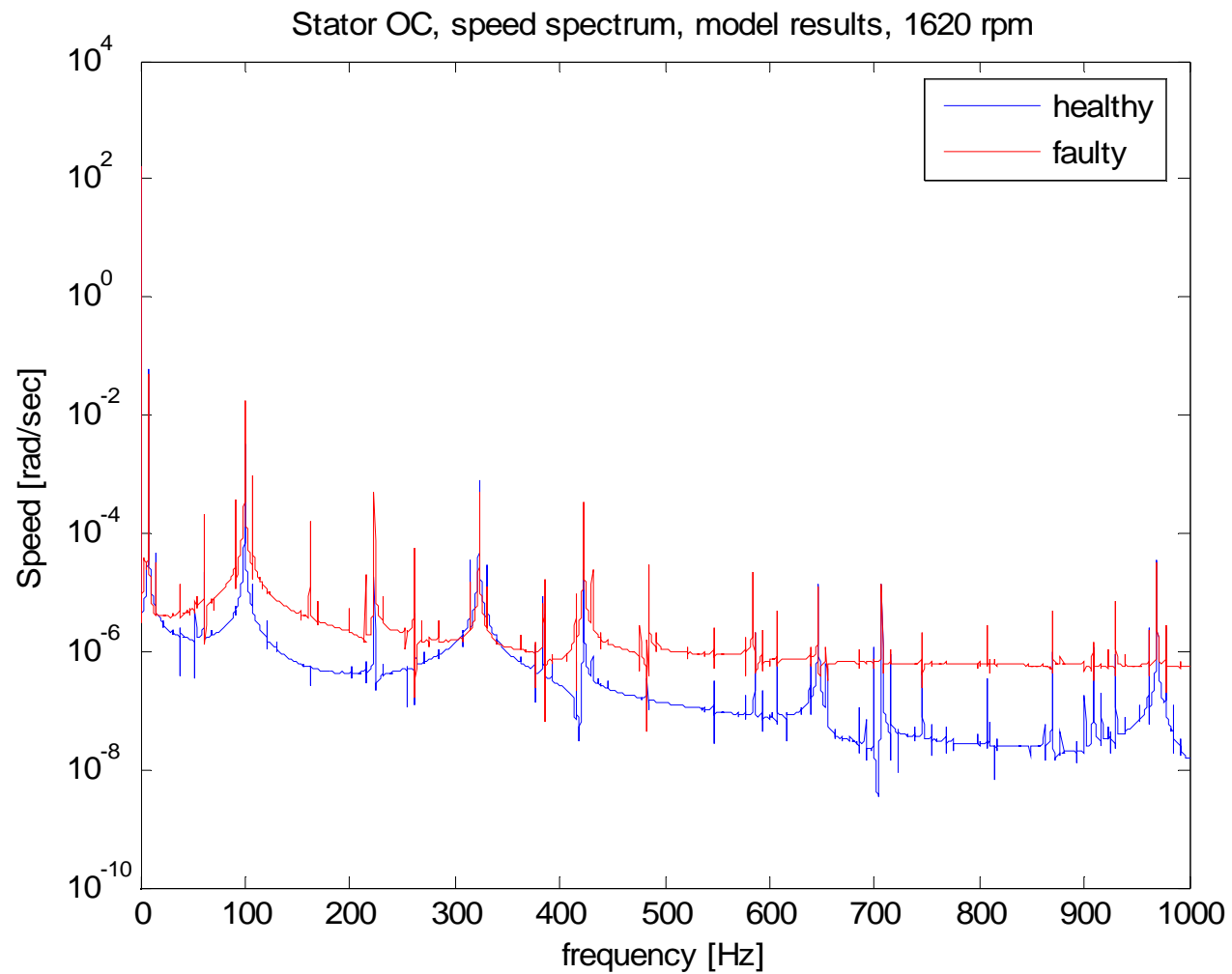
# The effects of a stator OC fault, Power spectrum (voltage supply asymmetry modelled, speed calculated)



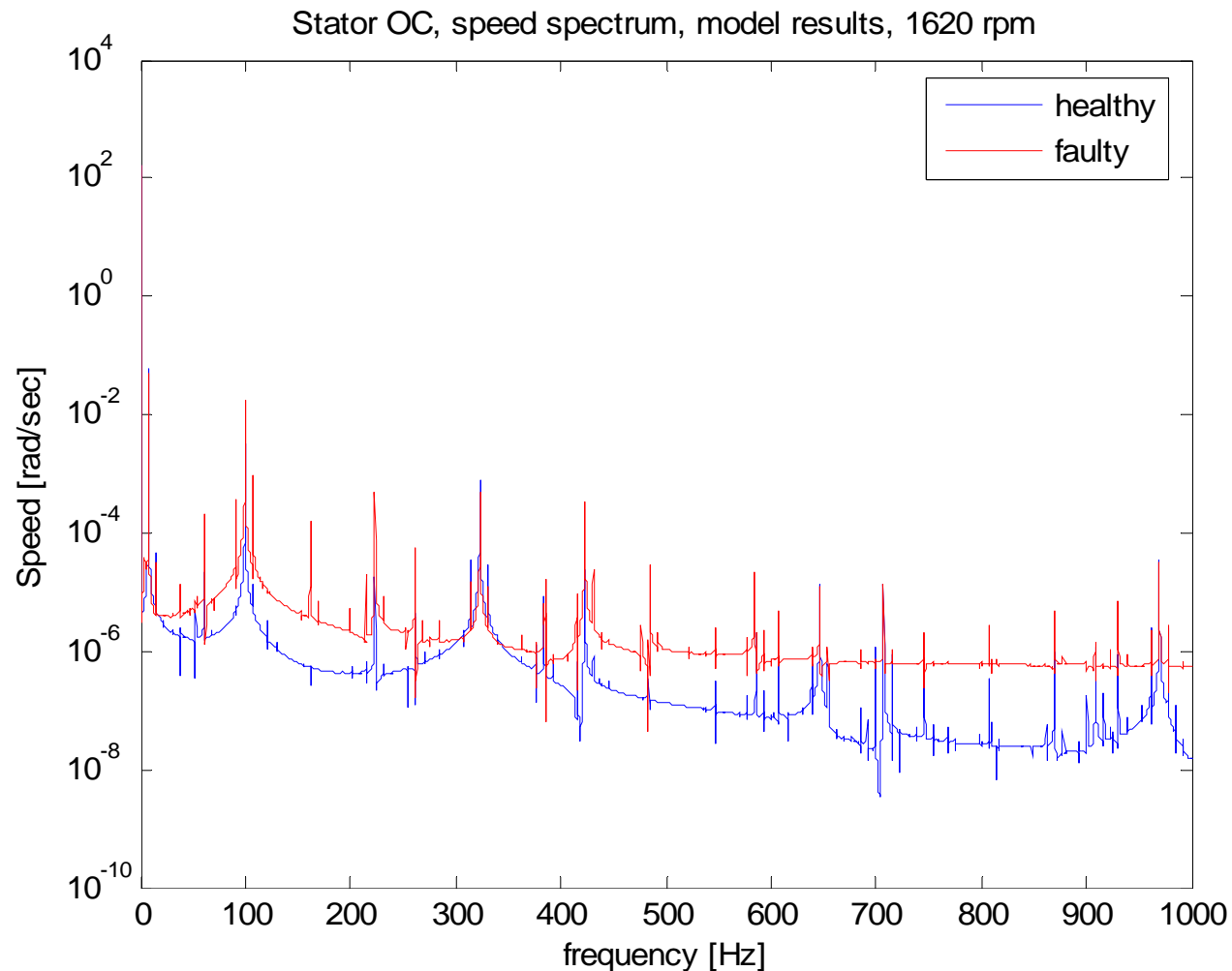
# The effects of a stator OC fault, Power spectrum (voltage supply asymmetry modelled, speed calculated)



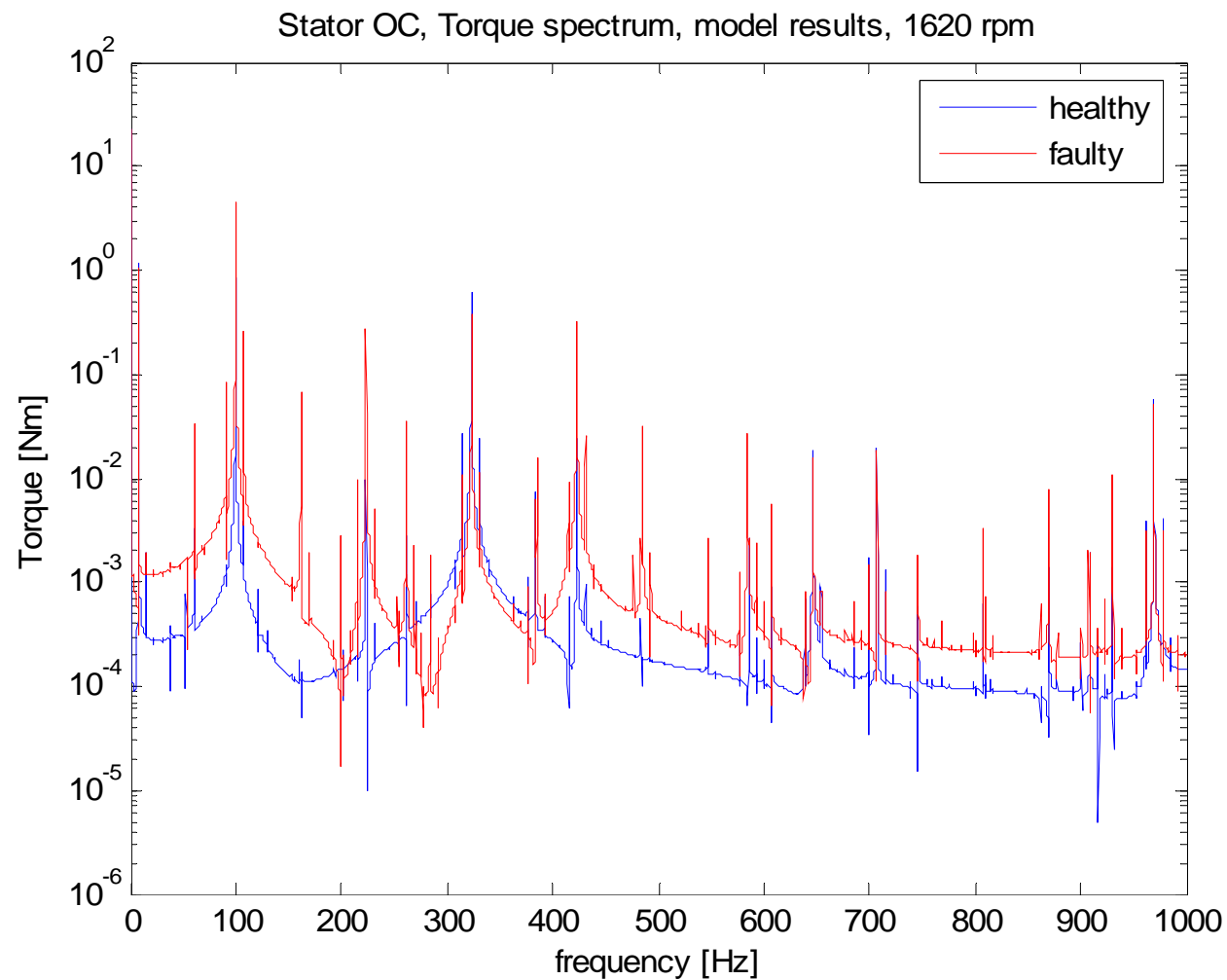
# The effects of a stator OC fault, Speed spectrum (voltage supply asymmetry modelled, speed calculated)



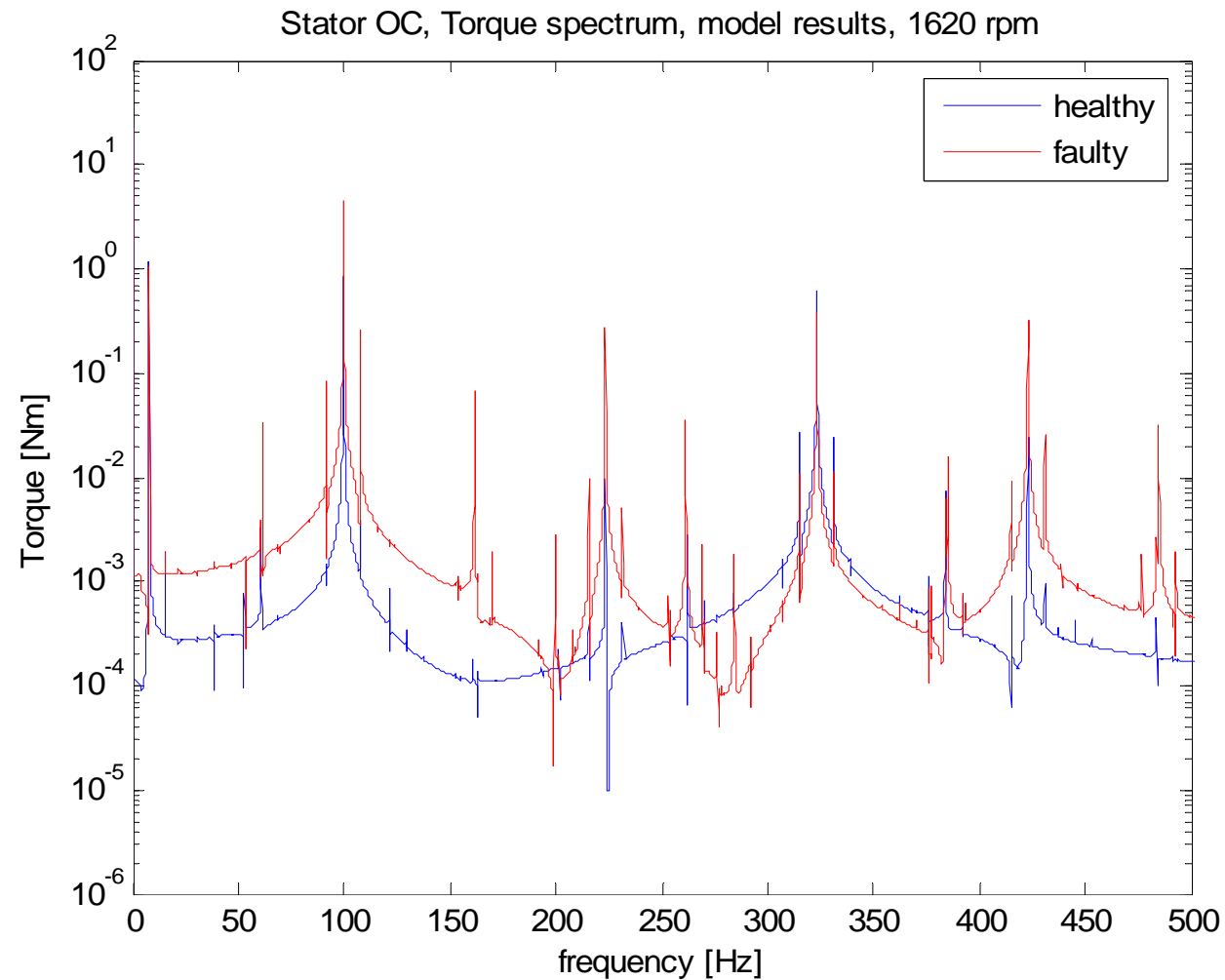
# The effects of a stator OC fault, Speed spectrum (voltage supply asymmetry modelled, speed calculated)



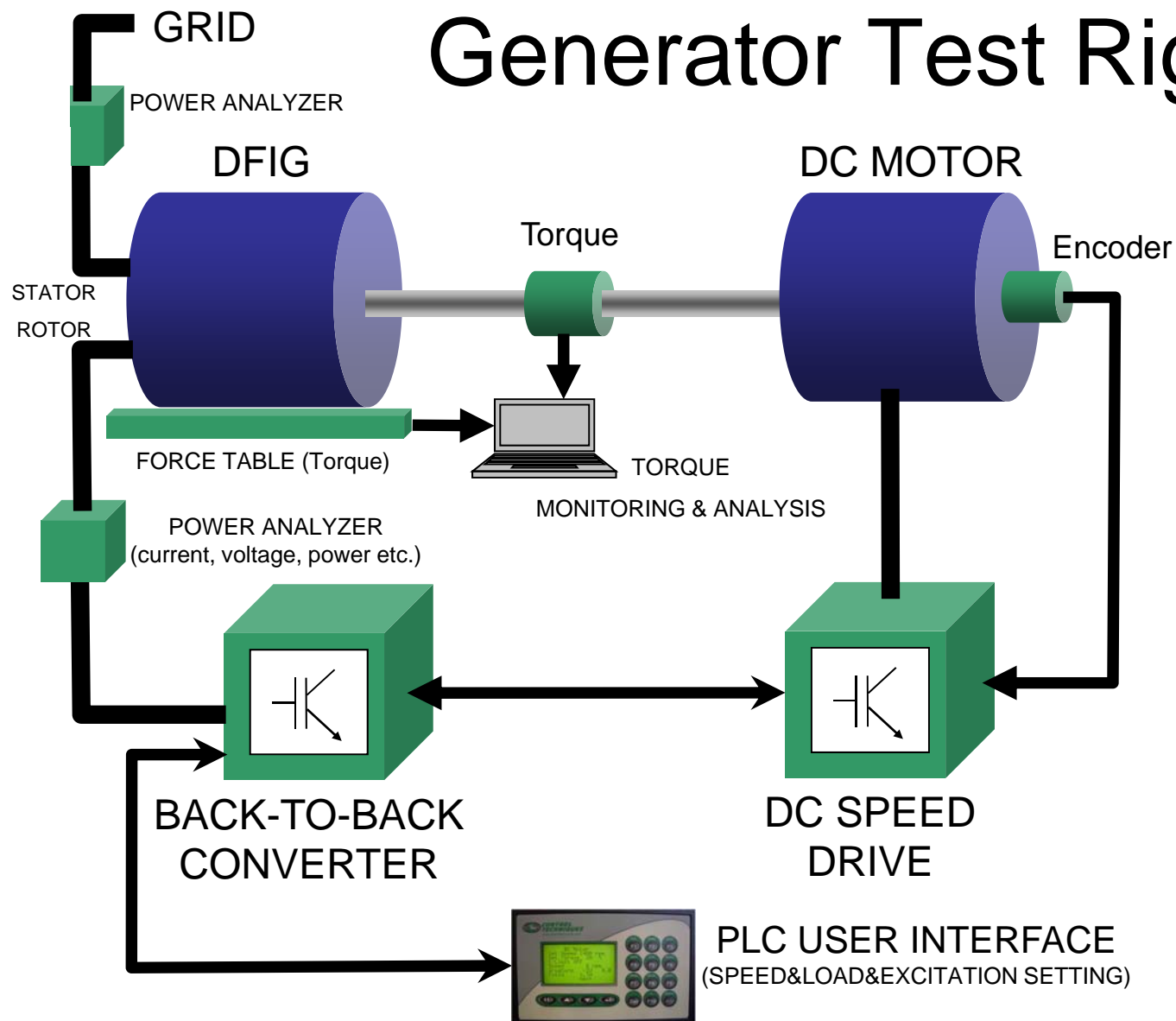
# The effects of a stator OC fault, Torque spectrum (voltage supply asymmetry modelled, speed calculated)



# The effects of a stator OC fault, Torque spectrum (voltage supply asymmetry modelled, speed calculated)



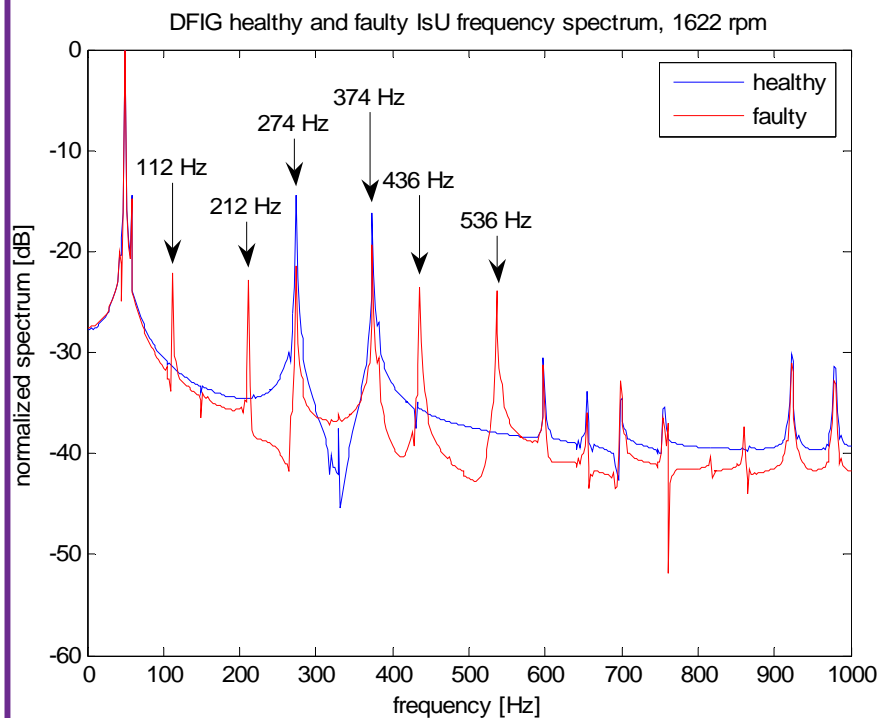
# Wind Turbine Generator Test Rig



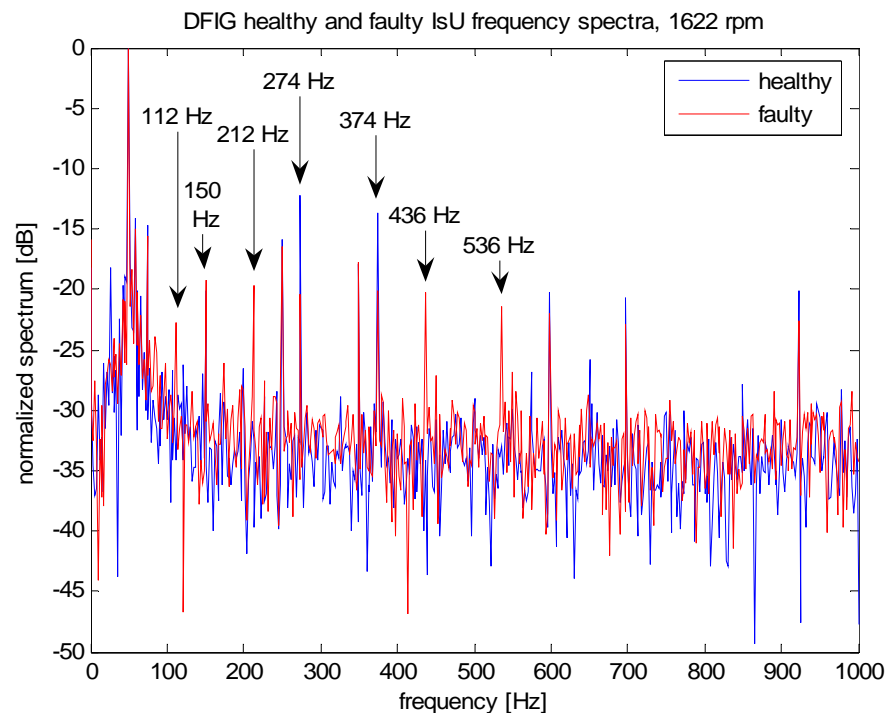
# Generator Test Rig

## Measured: Supply Current

### Fault: Stator Open Circuit Coil



Stator phase U current FFT spectrum:  
open circuit in phase U (model results)

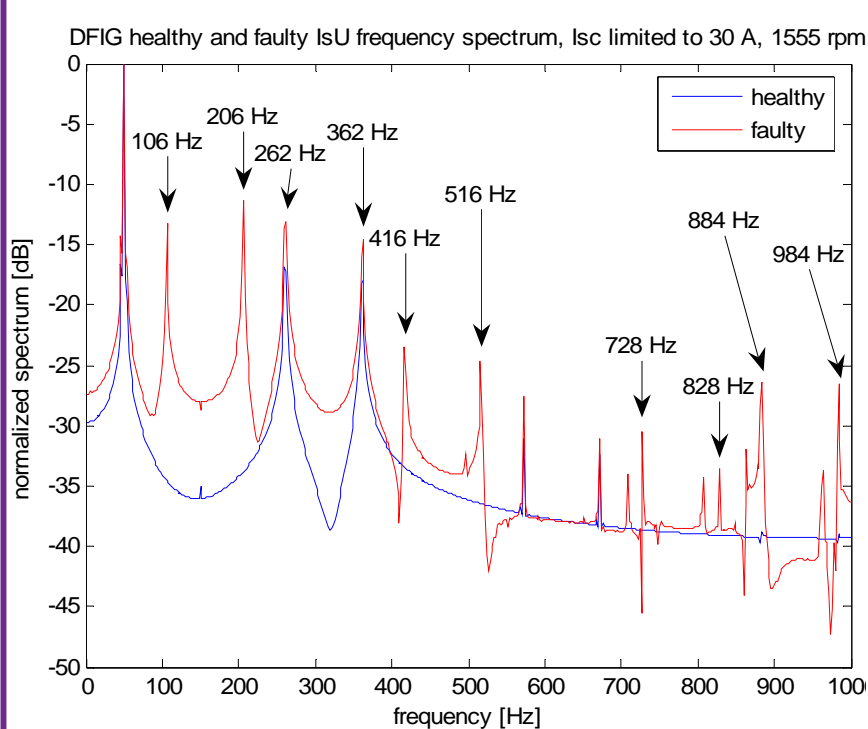


Stator phase U current FFT spectrum:  
open circuit in phase U (experimental results)

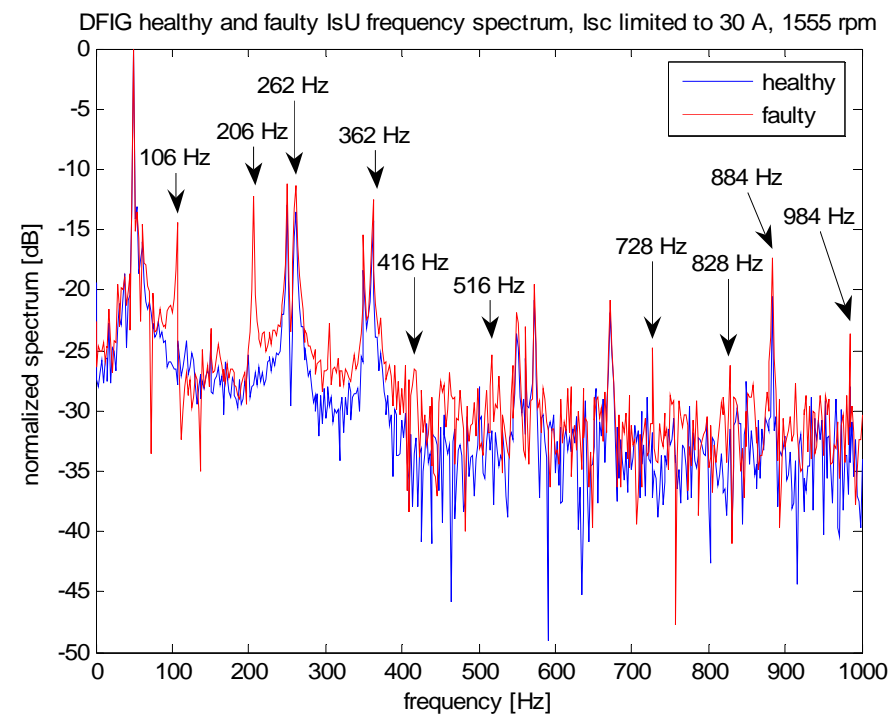
# Generator Test Rig

## Measured: Supply Current

### Fault: Stator Shorted Coil



Stator phase U current FFT spectrum:  
Short circuit in phase U (model results)



Stator phase U current FFT spectrum:  
short circuit in phase U (experimental results)