# Estimation of Broken Rotor in Induction Machine Using Spectral Analysis of Instantaneous Power

**Astrit BARDHI[1], Alfred PJETRI[2], Gentian DUME[3]**

[1]Polytechnic University of Tirana, Faculty of Electrical Enginering,
"Sheshi Nënë Tereza", Nr. 4, Albania

[2]Polytechnic University of Tirana, Faculty of Electrical Enginering,
"Sheshi Nënë Tereza", Nr. 4, Albania

[3]Polytechnic University of Tirana, Faculty of Electrical Enginering,
"Sheshi Nënë Tereza", Nr. 4, Albania

**Abstract:** ***In industry, a pivotal role is played by induction machines resulting in a strong demand for their respective reliable and safe operation. Faults and failures of induction machines can lead to excessive downtimes and generate large losses in terms of maintenance and revenues. Nowadays, experts are performing numerous researches to reduce both unexpected failures and maintenance cost by detecting faults during the machine activity operations. In this matter, measurements and monitoring must be performed during on-line conditions. In order to accurately identify the rotor bars damage, we have used spectral analysis of instantaneous power of induction machine, which are easily monitored. The instantaneous power provides the possibility to detect faults in induction machine. To confirm our theoretical analysis with experimental data, an induction machine was cut three rotor bars. The obtained theoretical and experimental results show coherence among each other.***

**Keywords:** Induction machine, rotor bars damage, instantaneous power, spectral analysis, on line monitoring**.**

## 1. Introduction

Induction motors, mainly due to their low cost, ruggedness, controllability, ability and low maintenance have become one of the most critical components for today's electric utilities and process industries. A motor failure, in such utilities, can result in the shutdown of a generating unit or production line. The presence of BRB brings about secondary malfunctions that reduces the efficiency of the motor and hence increase the operational cost. Accordingly, early detection of rotor failures, especially Broken Rotor Bars (BRB), is crucial. Any problem or irregularity in the machine can be detected at an early stage by applying a suitable condition monitoring accompanied with an effective signal processing method. In recent years, monitoring of induction motors has become very important to reduce maintenance costs and prevent unscheduled downtimes. Therefore, there has been a substantial amount of research to provide induction motors, new condition monitoring techniques. The failure of induction machine during operation can be fail due to normal ageing, assembling problem, operating mode, cooling conditions environment varieties or combination of a variety of faulty mechanisms.

In the survey reports by EPRI **[1]**, Thorsten & Dalva **[2]** found that 37% of motor failures have been by stator winding failures, 10% by rotor failures, 41% by bearing failures and 12% by miscellaneous failures. It should notice that failure emphasis's (defects) classification depends on operating mode and environmental conditions.

Rotor faults occur during manufacture stage also, through defective case casting of die cast rotors, poor jointing in the case of brazed case and welded end rings. Such faults result in a high resistance causing overheating and impaired cage strength at high temperatures. As a consequence, cracking can than occur in the rotor bar which usually take place at the cage end rings when the bars are unsupported by the rotor core **[3]**. During the induction machine operation, particularly when the machine operation in intermittent periodic duty mode, electrical, mechanical or thermal troubleshoots, can be present. In this case, the initially currents are six-seven times as nominal current and the motor running time is very short. High amount thermal energy is resulting to rotor bars cracking.

Base on literature survey data can be concluded that stator and rotor winding faults are approx. 50% of generally of induction machine defects **[4]**. For this reason, during the last years, the performed studies are predominantly focused how the on line monitoring of stator and rotor faults of induction machine under operation can be performed. In order to on line estimate of the rotor bar broken several methods as the spectral analysis of motor line current **[5-6]**, the monitoring of instantaneous torque **[7]**, the monitoring of frame vibration **[2]**, injection of low frequency signal **[8]**, the monitoring of axial flux **[9]** are proposed.

The aim of this article is to present another potential fault detection method which is based on the analysis of instantaneous power of induction machine. In normal condition operation the instantaneous power of induction machine is a constant value that depends on the motor load. In case of rotor bar defects as cracked bars or ring damage, the negative sequence of rotor currents induces in stator line currents with lower and upper twice-slip-frequency sidebands around the fundamental frequency. The instantaneous power of induction machine is not a constant value but variation with time. The oscillation depend by number of bar cracked and by motor load. The spectral analysis of instantaneous power of induction machine dominated by twice-slip-frequency, $2ksf_1$. The instantaneous power of induction machine can be monitored on line, requires no extra equipment and is easy to be used use by operators. To confirm our theoretical analysis with experimental data at the Laboratory of "Electrical Machine" of Electrical Engineering Faculty of our University, to simulate rotor faults three rotor bars of an induction machine have been cutter. The data obtained from experiments confirm very well the analysis developed in this paper.

## 2. The instantaneous power of induction machine

Initially an ideal three phase supply voltage is assumed in stator winding of induction machine working under normal conditions. The instantaneous power and maximum value of stator phase current are constant; the value of them depends on motor load. Then, we will analyze the induction machine working in faulty condition in case of rotor bars damage. The expression of total value of instantaneous power input of induction machine under faulty conditions is different from the one working under normal conditions. The total of instantaneous value of power oscillation with frequency $2ksf_1$

### 2.1. The instantaneous power of induction machine working under normal condition

Assuming symmetrical three-phase operation in the steady state, the three-phase winding is symmetrical and the feed by sinusoidal supply with frequency $f_1$. The voltage phase equation assuming as:

$$\begin{aligned} v_{sA}(t) &= V_m \cos(\omega_1 t) \\ v_{sB}(t) &= V_m \cos(\omega_1 t - 2\pi/3) \\ v_{sC}(t) &= V_m \cos(\omega_1 t - 4\pi/3) \end{aligned} \quad (1)$$

In steady state, through stator winding flow a symmetrical three phase currents with the same frequency $f_1$. The instantaneous values of stator phase currents of induction machine working under normal conditions can be expressed as follows:

$$\begin{aligned} i_{sA}(t) &= I_m \cos(\omega_1 t + \varphi) \\ i_{sB}(t) &= I_m \cos(\omega_1 t + \varphi - 2\pi/3) \\ i_{sC}(t) &= I_m \cos(\omega_1 t + \varphi - 4\pi/3) \end{aligned} \quad (2)$$

where $I_m$ is maximum value of stator phase current and $\phi$ is phase angle of stator current. The stator phase currents will produce a resultant forward magnetic field, rotating at synchronous speed **[10]**:

$$\Omega_1 = 2\pi n_1 = \frac{2\pi f_1}{p} = \frac{\omega_1}{p} \quad (3)$$

where $\Omega_1$ and $\omega_1$ are angular speed of magnetic field in geometric radians per second and electrical radian per second respectively, $n_1$ is the synchronous speed of magnetic field, in revolution per second and $p$ is the number of pole pairs. The magnetic flux created by currents passing in stator winding induces an electromotive force (EMF) and currents in the

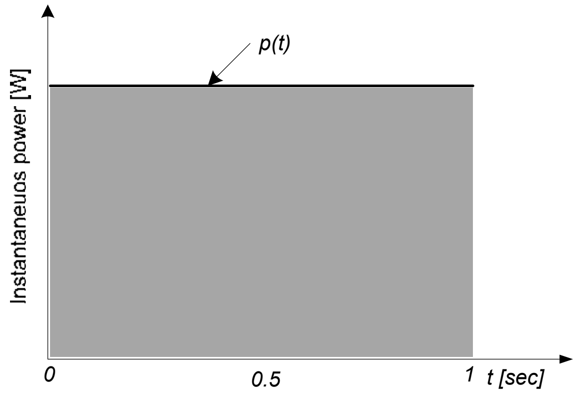


**Figure 1:** The instantaneous power of induction machine working under normal condition.

Rotor bars with frequency $sf_1$, where $s$ is motor slip. The rotor currents which flow in each of rotor bars are given by **[11]**:

$$i_{b,m} = I_b \cos(s\omega_1 t - m\phi) \quad (4)$$

where $i_{b,m}$ is the instantaneous value of $m$-bar of rotor current, $\phi = 2\pi p/Z_r$ is the angle between two neighbour rotor bars, $Z_r$ is number of rotor slots, $m$ is a integer 0, 1, 2, . . ., $Z_r - 1$ and $I_b$ is the maximum value of rotor bars currents. Each of rotor bars will produce a magnetic field with magneto-motive force (MMF) **[12]**:

$$f_{b,m}(\theta,t) = WI_b \cos[s\omega_1 t - m\phi]\cos[\theta - m\phi] \quad (5)$$

where $f_{b,m}$ is MMF of $m$ rotor bar and $\theta$ is air gap of induction machine in radians. The resultant MMF created by all rotor bars currents at an angle $\theta$ can be expressed as:

$$f_r(\theta,t) = \frac{Z_r}{4} I_b \cos(\theta - s\omega_1 t) \quad (6)$$

From Eq. (4), the resultant MMF created by rotor currents is rotated in the direction of stator MMF with angular speed $s\omega_1$, related to rotor frame. The angular speed of rotor MMF, $\Omega_2^{(1)}$, related to stator frame is:

$$\Omega_2^{(1)} = s\Omega_1 + \Omega = \Omega_1 \quad (7)$$

From Eq. (5) it is obvious that magnetic fields of the stator and rotor are rotated with same angular speed, forming thus the resultant air-gap magnetic field. The interaction between resultant air-gap flux and rotor bars currents creates a electromagnetic torque. The space vector of stator currents and voltage ($\bar{i}_s$ and $\bar{u}_s$) in stationary reference frame (fixed to the stator of the induction machine) can be obtained by the following expression [13]:

$$\bar{i}_s = \frac{2}{3}[i_{sA}(t) + a i_{sB}(t) + a^2 i_{sC}(t)] = \bar{I}_1 e^{j\omega_1 t} \quad (8)$$

$$\bar{v}_s = \frac{2}{3}[v_{sA}(t) + a v_{sB}(t) + a^2 v_{sC}(t)] = \bar{V}_1 e^{j\omega_1 t} \quad (9)$$

where $\bar{I}_1 = I_m e^{j\varphi}$ is space phasor of stator current , 1, $a$, $a^2$ are unit vectors in the direction of magnetic axes of stator phases [$a$ = exp(2π/3)]. The total input instantaneous power into the three phase of induction machine in case of working in normal condition can be express as follow:

$$p(t) = v_{sA}(t) i_{sA}(t) + v_{sB}(t) i_{sB}(t) + v_{sC}(t) i_{sC}(t) \quad (10)$$

Or in form of space vector

$$p=\frac{3}{2}\mathrm{Re}\left(\bar{u}_s \cdot \bar{i}_s^*\right)=3\bar{V}_1 \cdot \bar{I}_1\cos\varphi \qquad (11)$$

From Eq. (10), we show that the total of the instantaneous power of induction machine working under normal conditions is constant and does not vary with time. This situation is depicted graphically in Fig. 1.

### 2.2. The instantaneous power of induction machine working under faulty condition in case of broken rotor bars

The effect of broken rotor bars in expression of instantaneous of induction machine is analysed In this section analysed in this section. In previous section, it is assumed that induction machine is fed by symmetrical three-phase voltage with frequency $f_1$ and in stator winding flow symmetrical three phase currents with same frequency. Magnetic flux created by the stator currents induces an EMF at rotor bars with frequency $sf_1$. The damage of rotor bars cause asymmetry on the rotor circuit, therefore, through rotor winding will flow an asymmetrical current system. Magnetic field created by rotor currents can be analysed by symmetrical components. The positive sequence of rotor currents creates a magnetic field similar with symmetrical rotor (no faults) $F_2^{(1)}$. The rotor currents of negative sequence with frequency $sf_1$ creates a magnetic field which is rotated in opposite direction of the rotor with angular speed $\Omega_{22}^{(2)}=-s\Omega_1$ related to rotor reference frame $F_2^{(2)}$. The angular speed of rotor MMF of negative sequence, $\Omega_{21}^{(2)}$, with respect to the stator frame is:

$$\Omega_{21}^{(2)}=-s\Omega_1+\Omega=\left(1-2s\right)\Omega_1 \qquad (12)$$

In figure 2 there are shown the MMF of stator winding $\dot{F}_1$, positive $\dot{F}_2^{(1)}$ and negative MMF of rotor bars $\dot{F}_2^{(1)}$. The MMF of negative sequence of rotor currents induces EMF with frequency $f_{brb}=(1-2s)f_1$ at stator phase windings. This induced EMF causes at stator winding a current with same frequency. The instantaneous values of stator phase currents of induction machine working with rotor broken bars can be expressed as following:

$$\begin{aligned} i_{sA}(t) &= I_m\cos(\omega_1 t+\varphi) \\ &\quad +I_m'\cos[(1-2s)\,\omega_1 t+\varphi'] \\ i_{sB}(t) &= I_m\cos(\omega_1 t+\varphi-2\pi/3) \\ &\quad +I_m'\cos[(1-2s)\,\omega_1 t+\varphi'+2\pi/3] \\ i_{sC}(t) &= I_m\cos(\omega_1 t+\varphi-4\pi/3) \\ &\quad +I_m'\cos[(1-2s)\,\omega_1 t+\varphi'+4\pi/3] \end{aligned} \qquad (13)$$

where $I_m'$ is maximum value of $(1-2s)f_1$ harmonic and $\varphi'$ is its phase angle. The space vector of stator phase currents in stationary reference frame can be expressed by:

$$\begin{aligned} \bar{i}_s &= \frac{2}{3}[i_{sA}(t)+a i_{sB}(t)+a^2 i_{sC}(t)] \\ &= \bar{I}_1 e^{j\omega_1 t}+\bar{I}_1' e^{j[(1-2s)\omega_1 t]} \end{aligned} \qquad (14)$$

Eq. (13) shows, that in case of rotor bars damage, the space vector of stator line currents contain an extra component which rotates with angular speed $(1-2s)\omega_1$.

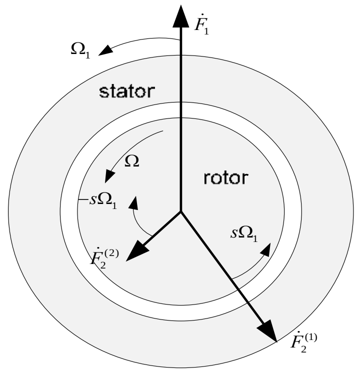


**Figure 2:** Space phasor of stator and rotor MMF of induction
machine working under damage rotor bars.

The amplitude of extra component depends on by motor loaded and the numbers of broken rotor bars **[12]**. Usually the rotor of induction machine is constructed by a large number bars, thus the current amplitude of negative sequence is very small compare to item positive sequence ($\bar{I}_1' \ll \bar{I}_1$). In this manner, the space vector magnitude of phase currents is pulsating with $(1-2s)f_1$ frequency. The instantaneous power of induction machine working in case of rotor bars damage condition can be expressed as follow:

$$\begin{aligned} p &= 3/2\,\mathrm{Re}\left(\bar{u}_s \cdot \bar{i}_s^*\right) \\ &= 3/2\,\mathrm{Re}\left[\bar{V}_1 e^{j\omega_1 t}\left(\bar{I}_1 e^{j\omega_1 t}+\bar{I}_1' e^{j[(1-2s)\omega_1 t]}\right)^*\right] \\ &= 3\bar{V}_1\cdot\bar{I}_1\cos\varphi_1+3\bar{V}_1\cdot\bar{I}_1'\cos\varphi'+3\bar{V}_1\cdot\bar{I}_1'\cos\left(2s\omega_1 t-\varphi'\right) \end{aligned} \qquad (15)$$

By Eq. (14), we show that the total of the instantaneous power into of induction machine working under normal conditions contains two components; one of them is constant and does not vary with time and the other changes periodically and oscillation by frequency $2sf_1$. This situation is depicted graphically in Fig.3. From equation (14), the constant component of instantaneous power is as following:

$$p=3\bar{V}_1\cdot\bar{I}_1\cos\varphi_1+3\bar{V}_1\cdot\bar{I}_1'\cos\varphi' \qquad (16)$$

The value of the oschilation components of instantaneous power follows by expression:

$$p=3\bar{V}_1\cdot\bar{I}_1'\cos\left(2s\omega_1 t-\varphi'\right) \qquad (17)$$

where :

$\bar{I}_1'$ is space phasor of $(1-2sf_1)$ harmonic of stator current

By comparing the expression (16-17) with expression (11) underline that instantaneous power of induction machine not only oscillation by $2sf_1$ frequency but the constant value of instantaneous power component increased. The power losses in induction machine also will increase and lower efficiency working under rotor damage. The Fig. 3 shows graphically instantaneous power of induction machine working under rotor bars damage. The interaction between the fundamental magnetic field of the stator with negative sequence of rotor current produces pulsating torque with frequency $2sf_1$**.** The pulsating torque will cause speed fluctuations of the rotor. Due to speed oscillation, in the stator winding of induction machine, side band components around the fundamental frequency have been induced. The frequency of the side band components corresponds to:

$$f_{brb,s} = (1 \pm 2ks) f_1 \quad (18)$$

where $f_{brb,s}$ are the side band frequencies due to broken rotor bars and $k$ is an integer 1, 2, 3, . . .. due to side band components in spectral analysis of instantaneous power appeared the harmonic $\pm 2ksf_1$.

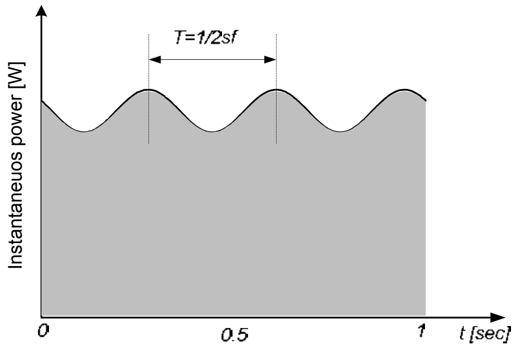


**Figure 3:** The instantaneous power of induction machine working under faulty condition. .

## 3. Experimental results

In order to confirm the above theoretical analysis of induction machine faults, a series of experiments are performed. The objects of the experiment we use a squirrel cage induction machines. The data of induction machine is listed in Table I. The induction machine is loaded by DC generators.

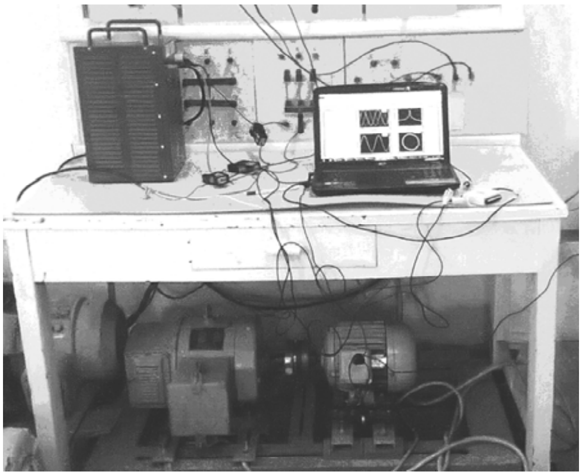

**Figure 4:** Experimental stand set up

The supply voltage of induction machines has been effectuated by a three phase balanced supply through a 3-phase variable auto-transformer. LabView software is used to visualization of waveform of phase currents, instantaneous power line and spectral analysis of instantaneous power of induction machine in case of working in normal condition and working with broken rotor bars.

### 3.1 Induction machine working under normal condition

The Fig. 4 shows the experimental stand for normal and rotor damage working conditions at the “Electrical Machine” Laboratory of Polytechnic University of Tirana. As a loaded for induction machine is used a DC generator. At fig 5 is show the instantaneous power line of induction machine in case of working under normal condition. The instantaneous power of induction machine as shown in fig.5 is a constant value as expected.

### 3.2 Induction machine working under broken rotor bars

Two rotor bars of induction machine at laboratory were cut definitely. The induction machine with broken rotor bars is experimented with different load. The waveform and instantaneous power line of induction machine are shown in fig. 6, 7 for motor loaded at half rated power. As shown at Fig. 6, the instantaneous power is not constant but variation in time. Also from fig. 7the amplitude of phase currents is not a constant value but changes periodically. The oscillation frequency of instantaneous power as shown at fig.6 is about 3 Hz. In fig 8 is representation spectral analysis of instantaneous power. As shown in experimental results the dominate frequency of instantaneous power is 3 and 6 Hz. The rotor speed of induction machine in case of half-loaded measured by stroboscopic method is related 1450 rpm and slip s=0.03. The theoretical harmonics of spectral analysis of instantaneous power according (14) are 3, 6 Hz. The Fig 9 represents the instantaneous power of induction machine with broken rotor bars loaded at rated power. As shown in fig 9, the instantaneous power is not constant value and frequency of oscillation increased. The Fig 10 represents the waveform of stator current of induction machine loaded at rated power under rotor bars damage. The rotor speed of induction machine in this case was 1405 rpm or slip 0.063. The Fig 10 represents the spectral analysis of instantaneous power of induction machine working at rated power. The appeared harmonics are respectively 6,25, 12,5 Hz. According (14) the theoretical frequency are 6,3, 12,6 Hz. The oscillation of phase’s stator current and instantaneous power line depends by motor loaded and degree of rotor bar damages. The data of rotor speed, slip frequency and spectral analysis of instantaneous power by different motor loaded are shown in Table I. Also in Table I are shown the calculated parameter as slip and frequency oscillation of instantaneous power. As shown in Table I, the oscillation of instantaneous power and magnitude of stator current depends by motor loaded.

**Table I: Data of induction machine experimented**

| $P_n$ | $V_n$ | $I_n$ | $f_n$ | $n_n$ | p |
|---|---|---|---|---|---|
| kW | V | A | Hz | rpm | pole pairs- |
| 3 | 230 | 6,9 | 50 | 1410 | 2 |

**Table I: Data of calculated and measured of instantaneous power harmonics**

| Nr | measured | | | calculated | | |
|---|---|---|---|---|---|---|
| | n [rpm] | $f_{p1}$ | $f_{p2}$ | s | $2sf_1$ [Hz] | $4sf_1$ [Hz] |
| 1 | 1489 | - | - | 0.0073 | 0.73 | 1,46 |
| 2 | 1470 | 2 | 4 | 0.02 | 2 | 4 |
| 3 | 1454 | 3 | 6 | 0.0306 | 3 | 6 |
| 4 | 1441 | 3.9 | 7.8 | 0.039 | 3.9 | 7.8 |
| 5 | 1425 | 5.1 | 10.2 | 0.05 | 5 | 10 |

International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | 1405 | 6.25 | 12.5 | 0.063 | 6.3 | 12,6 |

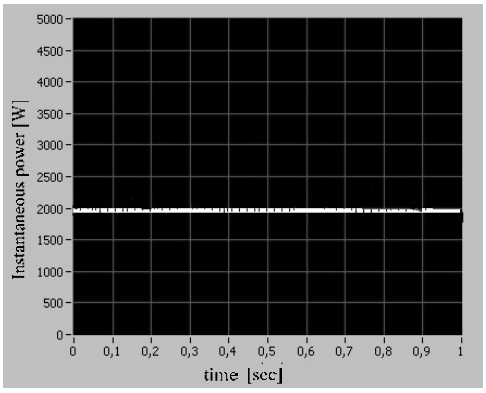


**Figure 5** Instantaneous power of induction machine working under normal condition

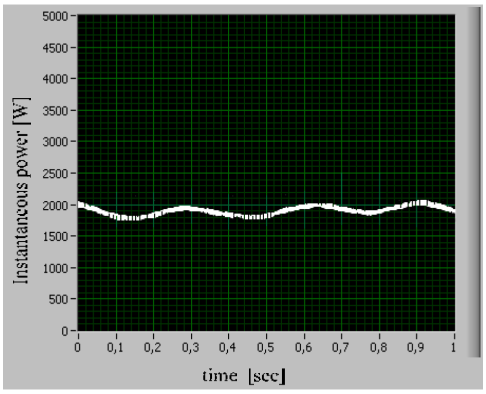


**Figure 6:** Instantaneous power of induction machine loaded half rated power working under rotor bar damage.

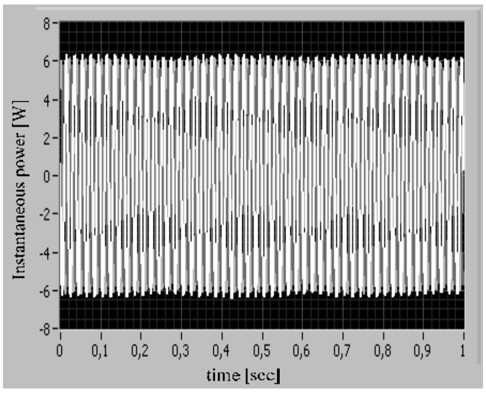


**Figure 7:** Instantaneous currents of induction machine loaded at half rated power working under rotor bar damage.

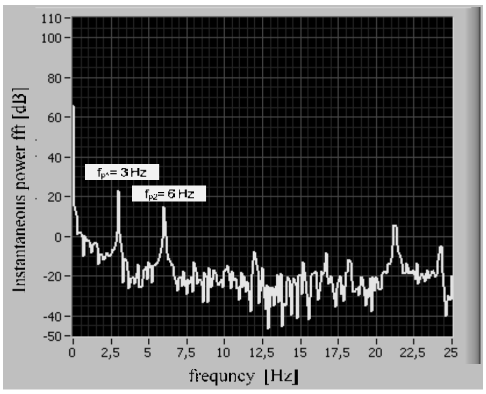


**Figure 8:** Spectral analysis of instantaneous power of induction machine loaded at half rated power working under rotor bar damage.

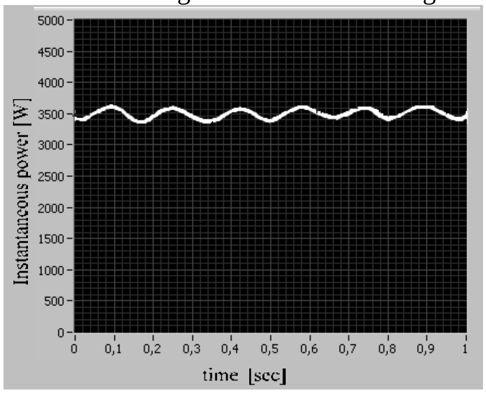


**Figure 9:** Instantaneous power of induction machine loaded at rated power working under rotor bar damage

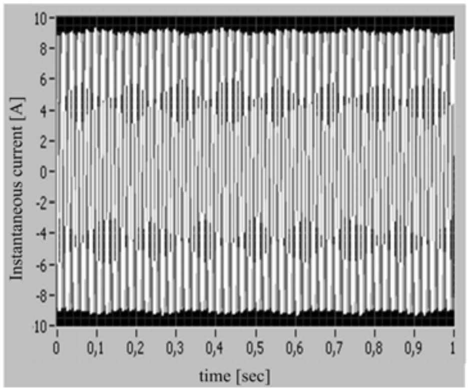


**Figure 10:** Instantaneous currents of induction machine loaded at rated power working under rotor bar damage.

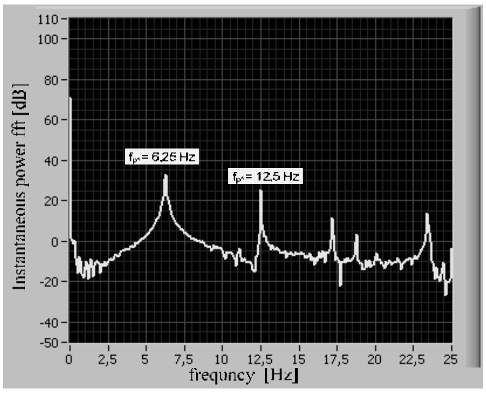


**Figure 11:** Spectral analysis of instantaneous power of induction machine loaded at rated power working under rotor bar damage.

## 4. Conclusion

In this paper we have demonstrated a simple method for detection of rotor bars faults at induction machine. The method is based on monitoring of instantaneous power line. The instantaneous power line of IM working under normal condition is a constant value. The instantaneous power line of IM in case of broken rotor bars oscillating with frequency $2sf_1$.

The oscillation of instantaneous power depends on motor loaded and broken rotor bars. The vibration and noises increased in IM under working with rotor bars damage.

The instantaneous power and stator phase currents can be monitored easily without interfering on the motor regime, by monitoring the instantaneous power we can detect rotor bars faults of induction machine at early stage.

## References

[1] EPRI, 1982. "Improved Motors for Utility Applications", Publication EL-2678, Vol. 1, 1763-1, final report.
[2] Thorsen, O.V., Dalva, M., 1999. "Failure identification and analysis for high voltage induction motors in the petrochemical industry", IEEE Transactions on Industry Applications", pp. 1186-1196.
[3] Tavner P.J., Penman J., 2008. "Condition monitoring of Electrical Machine", Willey & Sons, New York.
[4] Nandi S., et al., 2005. "Condition monitoring and fault diagnosis of electrical motors – a review". IEEE Transactions on Energy Conversion; 20(4), pp.719-29.
[5] Thomson, W.T., Fenger, M. 2001. "Curent signature analysis to detect induction motor faults". IEEE Industry Applications Magazine; 7, pp. 26-34.
[6] Thomson, W.T., Fenger, M. 2001. "Curent signature analysis to detect induction motor faults". IEEE Industry Applications Magazine; 7, pp. 26-34.
[7] Bellini, A., et al., 2001. "Quantitative Evaluation of Induction Motor Broken Bars by Means of Electrical Signature Analysis", IEEE Transactions on Industry Applications, Volume 37, Issue 5, pp.
[8] Ho, S.L., Cheg, K.W.E., 1998. "Condition Monitoring of Rotor Faults in Induction Motors by Injection of Low Frequency Signal into The Supply", Seventh International Conference on Power Electronics and Variable Speed Drives,. (IEE Conf. Publ. No. 456), 21-23 pp. 200-205
[9] Jarzyna, W., 1995. "Diagnostic Characteristics of Axial Flux in An Induction Machine", Seventh International Conference on Electrical Machines and Drives, (Conf. Publ. No. 412), 11-13, pp. 141-146
[10] Xhoxhi N., Luga Y., 1989. "Electric Machine" (in albanian), Vol. 2, SHBLU.
[11] Maliti, K.C., 2000. "Modeling and Analysis of Magnetic Noise in Squirrel-Cage Induction Motors", Doctoral Dissertation, Royal Institute of Technology, Stockholm.
[12] Sribovornmonkol, Th., 2006. "Evaluation of Motor on Line Diagnosis by FEM Simulations", Royal Institute of Technology, Stockholm.
[13] Vas, P., 1993. "Parameter Estimation, Condition Monitoring, and Diagnosis of Electrical Machines", Oxford University Press.

## Author Profile

**Astrit Bardhi** was born in Tirana, Albania, in 1972. He received the Engineer degree in Electrical Engineering from the Polytechnic University of Tirana, Albania, in 2002, and the MSc degree in Power System and intelligent techniques from the same school in 2007. Hi obtained the doctorate thesis on December 2011 in Electrical Engineering. He is an Assistant teacher at Electrical Engineering Faculty of Polytechnic University of Tirana. His current research interests include electric machines, fault detection and localization, modeling and observation.

**Alfred Pjetri** was born in Mirdita, Albania, in 1981. He received the Engineer degree in Electrical Engineering from the Polytechnic University of Tirana, Albania, in 2005, and the MSc degree in Automation system at the same school in 2010. He is an Assistant teacher at Electrical Engineering Faculty of Polytechnic University of Tirana. His current research interests include electric drives, modeling and observation

**Gentian Dume** was born in Durresi, Albania, in 1982. He received the Engineer degree in Electrical Engineering from the Polytechnic University of Tirana, Albania, in 2006. He is an Assistant teacher at Electrical Engineering Faculty of Polytechnic University of Tirana His current research interests include measurement and signal processing.