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A STUDY OF THE TECHNICAL PERFORMANCES OF THE EXECUTION ELEMENT ASYNCHRONOUS MOTOR – FREQUENCY INDIRECT STATIC CONVERTER

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Abstract **– This paper present theoretical aspects and experimental results about technical investigation of the assembly asynchronous motor – static frequency converter, with intermediary circuit voltage type.**
The converter of the rectifier is not commanded type, and the inverter is with IGBT transistors, commanded by the microcontroller PWM signals.
The equipment was experimented in three regimes: the converter in no-load regime; asynchronous motor in no-load regime; asynchronous motor in load regime.
Experimented issues to refer to: registration of the indicial response of the motor speed, and the detection of the mechanical time constant; registration of the indicial response of the motor speed, and the detection of the electromagnetically time constant; registration of the wave form of the voltage at the motor terminal, and her harmonic analysis; registration of the wave form of the phase current, and her harmonic analysis; analysis of the starting moment for the motor; calculus of the thermal constant.
The experiments are done with different type of static converters: Siemens, Danfoss, and UEM Resita types. The commands algorithms for the converters assign a constant stator flux, in the under nominal speed domain.
The registration for the parameters was done on-line, using virtual instruments and LabVIEW data acquisition systems. Were experimented 36 converters, different types.

Keywords: *static converter, harmonic analysis, asynchronous motor, PWM signals, indicial response.*

1. INTRODUCTION

The technical performances of the assembly asynchronous motor – static frequency converter influence the behavior of control systems, of speed rotation in transitory and stationary regimes.
The calculus of the performances in the time and frequency domains offer to the designers the possibilities of an right synthesis of the control systems, of speed rotation for different working machines.

2. THEORETICAL CONSIDERATIONS

The structure of the actuator used in the test time is presented in figure 1.

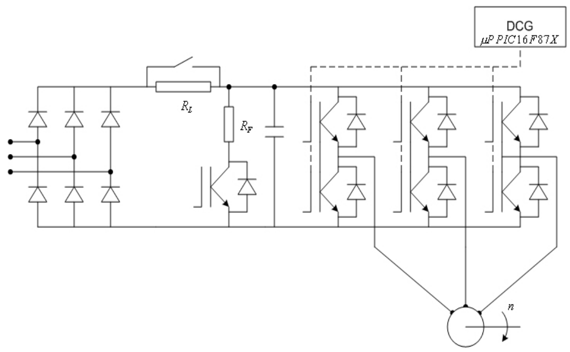

Figure 1. Asynchronous motor – static frequency converter assembly (U/f=ct.).

The speed closed loop function is determinate with the schema presented in figure 2.

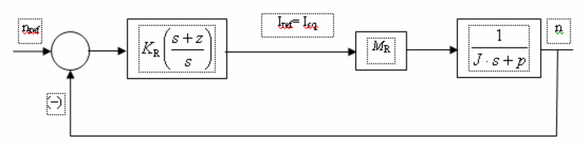

Figure 2. The structural schema of the speed closed loop.

$$H(\mathrm{s}) = \frac{n(s)}{n_{\mathrm{ref}}(s)} = \frac{K_{\mathrm{R}} \cdot M_{\mathrm{R}}(s+z)}{J \cdot s^2 + s(p + M_{\mathrm{R}} \cdot K_{\mathrm{R}}) + M_{\mathrm{R}} \cdot K_{\mathrm{R}} \cdot z} \tag{1}$$

where: K_{R} is the regulator amplifier factor, $z = \frac{1}{T_{\mathrm{i}}}$, T_{i} is integration time constant, M_{R} is resistance torque, J and p – mechanical parameters of the work machine (motor rotor included).

3. EXPERIMENTAL RESULTS

After the laboratory tests, with many types static frequency converter, with indirect static converter, voltage supplies type, we achieved follows results.

3.1. Asynchronous motor connected at the static frequency converter type Frequenzumrichter /AC Drive SIMOVERT FC

3.1.1. Measures and acquisitions with converter in no-load regime

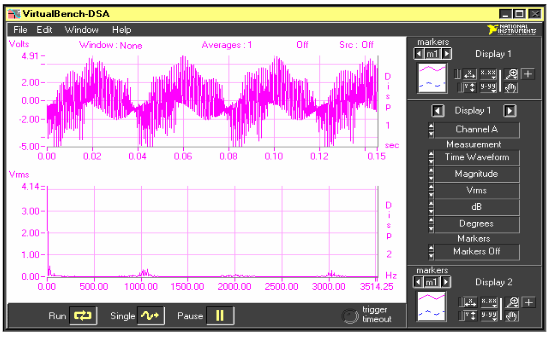

Figure 3. Harmonic analysis of the line voltage with converter in no-load regime, at *f*=25.02 Hz.

3.1.2. Measures and acquisitions with asynchronous motor in no-load regime

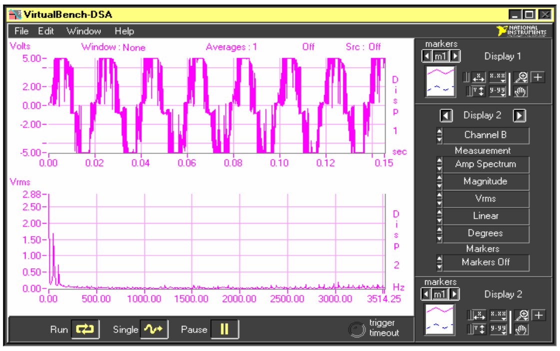

Figure 4. Harmonic analysis of the line voltage with asynchronous motor in no-load regime, at f=50.73 Hz.

3.1.3. Measures and acquisitions with asynchronous motor in load regime

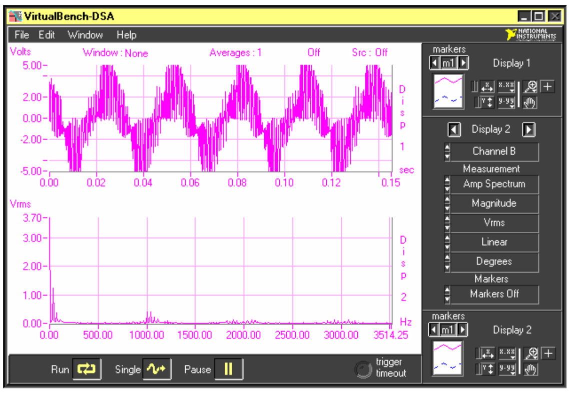

Figure 5.a. Harmonic analysis of the line voltage with asynchronous motor in load regime, at *f*=35.60 Hz.

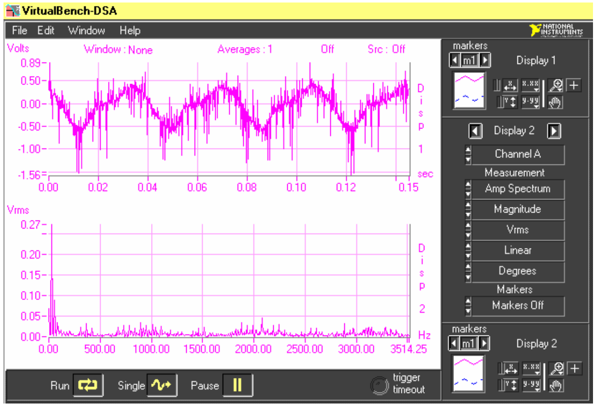

Figure 5.b. Harmonic analysis of the phase current at I=3 A, and f=35.60 Hz.

3.2. Asynchronous motor connected at the static frequency converter type Wechselrichter/DC Invert SIMOVERT VC

3.2.1. Measures and acquisitions with converter in no-load regime Section headings

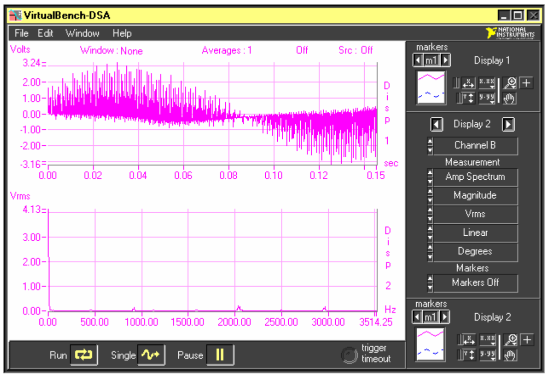

Figure 6. Harmonic analysis of the line voltage with converter in un-load regime, at *f*=5 Hz.

3.2.2. Measures and acquisitions with asynchronous motor in no-load regime

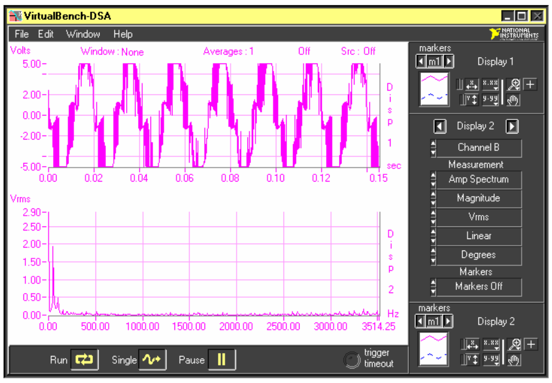

Figure 7. Harmonic analysis of the line voltage with asynchronous motor in un-load regime, at *f*=50 Hz.

3.2.3. Measures and acquisitions with asynchronous motor in load regime

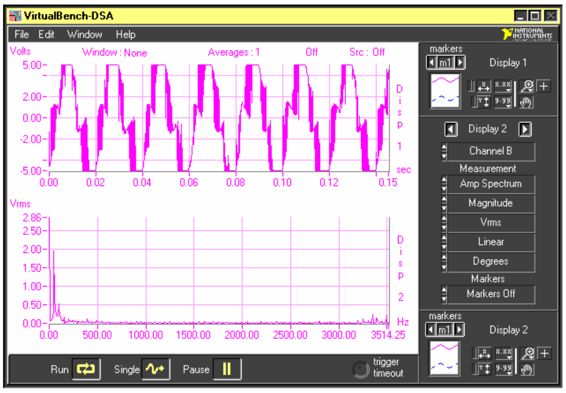

Figure 8.a. Harmonic analysis of the line voltage with asynchronous motor in load regime, at f=27 Hz.

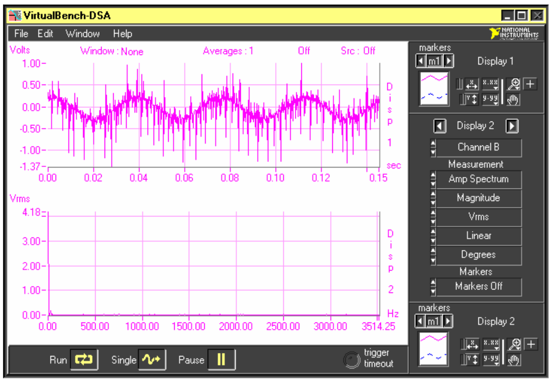

Figure 8.b. Harmonic analysis of the phase current, at I=1 A, and f=27 Hz.

3.3. The instability zone of the system when MRAS (rotor-flux model reference adaptive system)

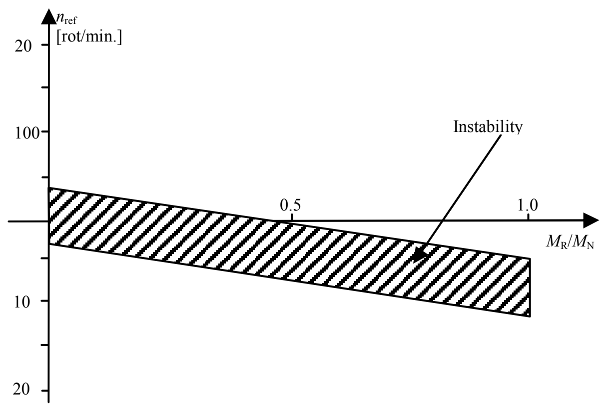

Figure 9. The functioning instability zone of the system, $n_{ref}=f(M_R)$.

4. CONCLUSIONS

After the experiments we concluded:
- the inverter command algorithm determine the starting couple, and the transitory regime for the control system;
- the parameters of the PWM signals determine the harmonic analysis of the voltage;
- between the prescribed frequency and the moment of inertia of the load exist a close connection;
- the settings of maximal parameters for the converter protection is done with the load, and with the performances in transitory regime of control system;
- intermediary circuit of the converter was formatted, and bring to the nominal capacity after a conservation period of 6 years;
- voltage harmonic factor is small at the converter type SIMOVERT VC;
- electromagnetic time constant is small for all converter types;
- the incorrect settings of converter parameters cause the blocking of command impulses at the inverter;
- indicial temperature response permit the determination of the thermal time constant of the actuator (between 0.1–1 h);
- never been used external filters, of any type.

The registrations, the measurements, and the setting of optimal parameters for the actuator may be used by specialists on diverse domains: design, production, and research.

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