N86-30203

ORBITS - COMPUTER SIMULATION

Agnes Muszynska
Bently Rotor Dynamics Research Corporation
Minden, Nevada 89423

In rotating machinery dynamics an orbit (Lissajous curve) represents the dynamic path of the shaft centerline motion during shaft rotation and resulting precession. The orbit can be observed with an oscilloscope connected to XY proximity probes. The orbits can also be simulated by a computer.

OBJECTIVE

The software for HP computer simulates orbits for two cases:

(1) Symmetric orbit with four frequency components with different radial amplitudes and relative phase angles.

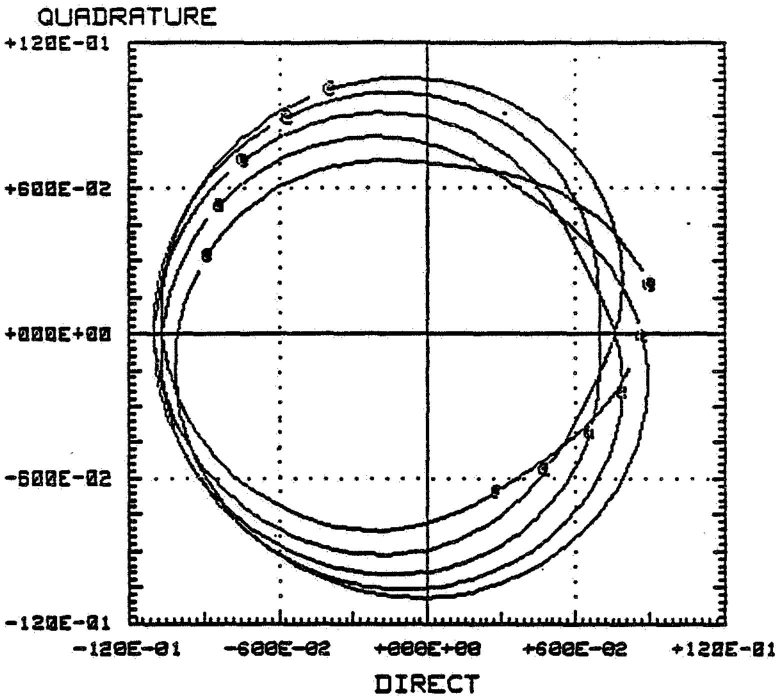
(2) Nonsymmetric orbit with two frequency components with two different vertical/horizontal amplitudes and two different relative phase angles.

Each orbit carries a Keyphasor mark (one-per-turn reference). The frequencies, amplitudes, and phase angles, as well as number of time steps for orbit computation, have to be chosen and introduced to the computer by the user.

The orbit graphs can be observed on the computer screen. Hard copies are available from the corresponding plotter.

RESULTS

Figures 1 through 5 give the examples of the computer-generated orbits, simulating various rotating machine malfunctions.



**** DATA ****

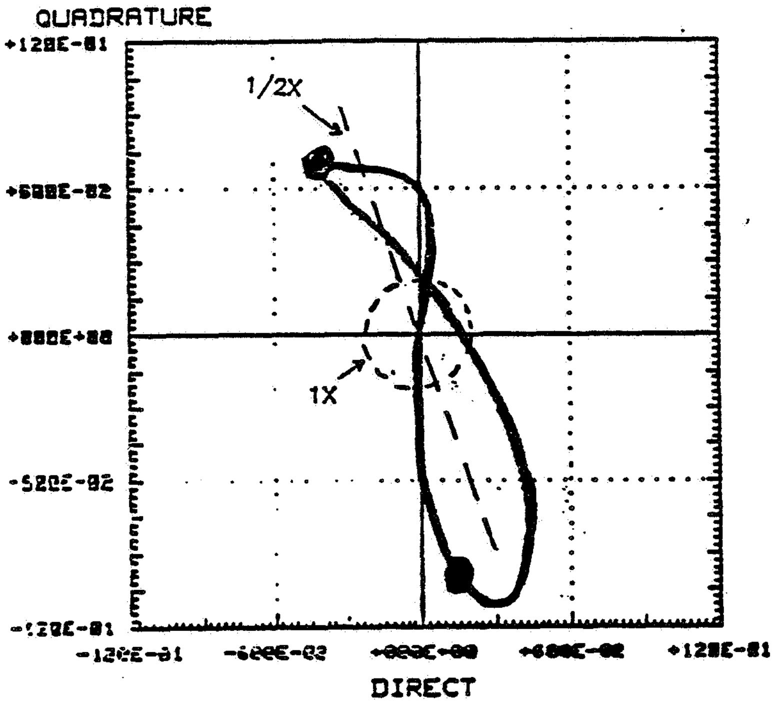
1.)	AX1	:	HORIZONTAL AMPLITUDE OF THE 1ST COMPONENT ***************	2
2.)	AY1	:	VERTICAL AMPLITUDE OF THE 1ST COMPONENT *****************	2
3.)	AX2	:	HORIZONTAL AMPLITUDE OF THE 2ND COMPONENT ***************	9
4.)	AY2	:	VERTICAL AMPLITUDE OF THE 2ND COMPONENT *****************	9
5.)	ALPX1	:	HORIZONTAL PHASE ANGLE OF THE 1ST COMPONENT [DEG] *******	90
6.)	ALPY1	:	VERTICAL PHASE ANGLE OF THE 1ST COMPONENT [DEG] *********	90
7.)	ALPX2	:	HORIZONTAL PHASE ANGLE OF THE 2ND COMPONENT [DEG] *******	0
8.)	ALPY2	:	VERTICAL PHASE ANGLE OF THE 2ND COMPONENT [DEG] *********	0
9.)	OME1	:	FREQUENCY OF THE 1ST COMPONENT [RAD/SEC] ****************	100
10.)	OME2	:	FREQUENCY OF THE 2ND COMPONENT [RAD/SEC] ****************	48
11.)	NMAX	:	NUMBER OF 'TIME'-STEPS **********************************	900

**** ROTOR ORBITAL MOTION ****

x=(Ax1)cos(omega1*t+alphax1)+(Ax2)cos(omega2*t+alphax2)

y=(Ay1)sin(omega1*t+alphay1)+(Ay2)sin(omega2*t+alphay2)

Figure 1. - Orbit simulating oil whirl.



**** DATA ****

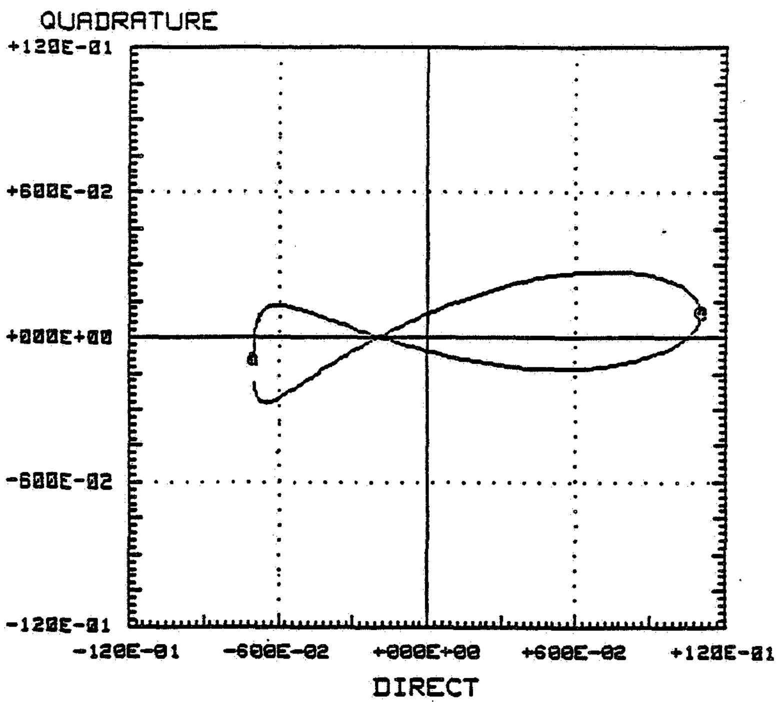
1.)	AX1	:	HORIZONTAL AMPLITUDE OF THE 1ST COMPONENT ***************	2
2.)	AY1	:	VERTICAL AMPLITUDE OF THE 1ST COMPONENT *****************	2
3.)	AX2	:	HORIZONTAL AMPLITUDE OF THE 2ND COMPONENT ***************	3
4.)	AY2	:	VERTICAL AMPLITUDE OF THE 2ND COMPONENT *****************	9
5.)	ALPX1	:	HORIZONTAL PHASE ANGLE OF THE 1ST COMPONENT [DEG] *******	225
6.)	ALPY1	:	VERTICAL PHASE ANGLE OF THE 1ST COMPONENT [DEG] *********	225
7.)	ALPX2	:	HORIZONTAL PHASE ANGLE OF THE 2ND COMPONENT [DEG] *******	20
8.)	ALPY2	:	VERTICAL PHASE ANGLE OF THE 2ND COMPONENT [DEG] *********	290
9.)	OME1	:	FREQUENCY OF THE 1ST COMPONENT [RAD/SEC] ****************	100
10.)	OME2	:	FREQUENCY OF THE 2ND COMPONENT [RAD/SEC] ****************	-50
11.)	NMAX	:	NUMBER OF 'TIME'-STEPS **********************************	300

**** ROTOR ORBITAL MOTION ****

x=(Ax1)cos(omega1+alphax1)+(Ax2)cos(omega2+alphax2)

y=(Ay1)sin(omega1+alphay1)+(Ay2)sin(omega2+alphay2)

Figure 2. - Orbit simulating vertical partial rotor-to-stator rub.



**** DATA ****

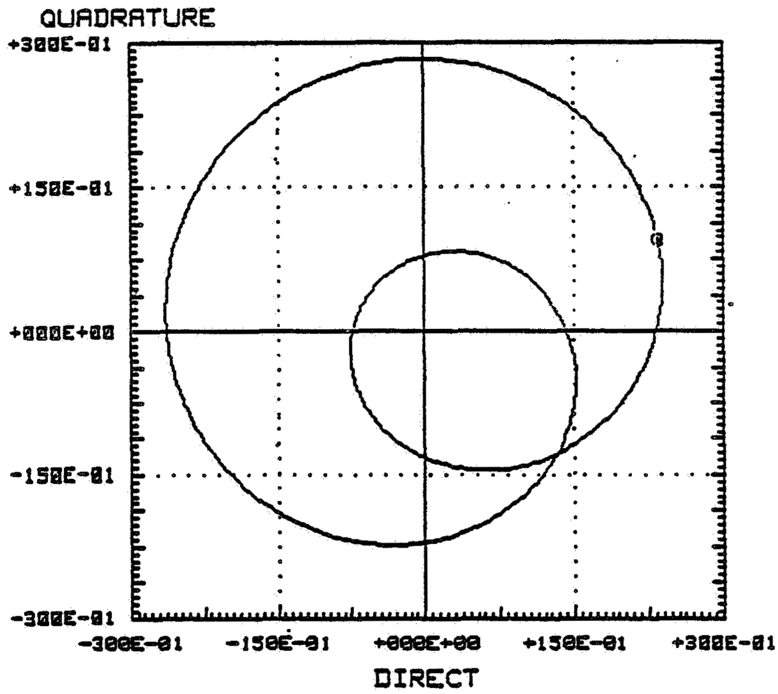
1.)	AX1	:	HORIZONTAL AMPLITUDE OF THE 1ST COMPONENT ***************	2
2.)	AY1	:	VERTICAL AMPLITUDE OF THE 1ST COMPONENT *****************	2
3.)	AX2	:	HORIZONTAL AMPLITUDE OF THE 2ND COMPONENT ***************	9
4.)	AY2	:	VERTICAL AMPLITUDE OF THE 2ND COMPONENT *****************	1
5.)	ALPX1	:	HORIZONTAL PHASE ANGLE OF THE 1ST COMPONENT [DEG] *******	0
6.)	ALPY1	:	VERTICAL PHASE ANGLE OF THE 1ST COMPONENT [DEG] *********	0
7.)	ALPX2	:	HORIZONTAL PHASE ANGLE OF THE 2ND COMPONENT [DEG] *******	0
8.)	ALPY2	:	VERTICAL PHASE ANGLE OF THE 2ND COMPONENT [DEG] *********	90
9.)	OME1	:	FREQUENCY OF THE 1ST COMPONENT [RAD/SEC] ****************	100
10.)	OME2	:	FREQUENCY OF THE 2ND COMPONENT [RAD/SEC] ****************	-50
11.)	NMAX	:	NUMBER OF 'TIME'-STEPS **********************************	300

**** ROTOR ORBITAL MOTION ****

x=(Ax1)cos(omega1*t+alphax1)+(Ax2)cos(omega2*t+alphax2)

y=(Ay1)sin(omega1*t+alphay1)+(Ay2)sin(omega2*t+alphay2)

Figure 3. - Orbit simulating horizontal partial rotor-to-stator rub.



z = (10)EXP(j(50t+70)) + (10)EXP(j(100t+0)) + (1)EXP(j(150t+0))
+ (1)EXP(j(200t+0))

FIRST COMPONENT IS SYNCHRONOUS

ROTOR ORBITAL MOTION

Figure 4. - Orbit simulating cracked shaft.

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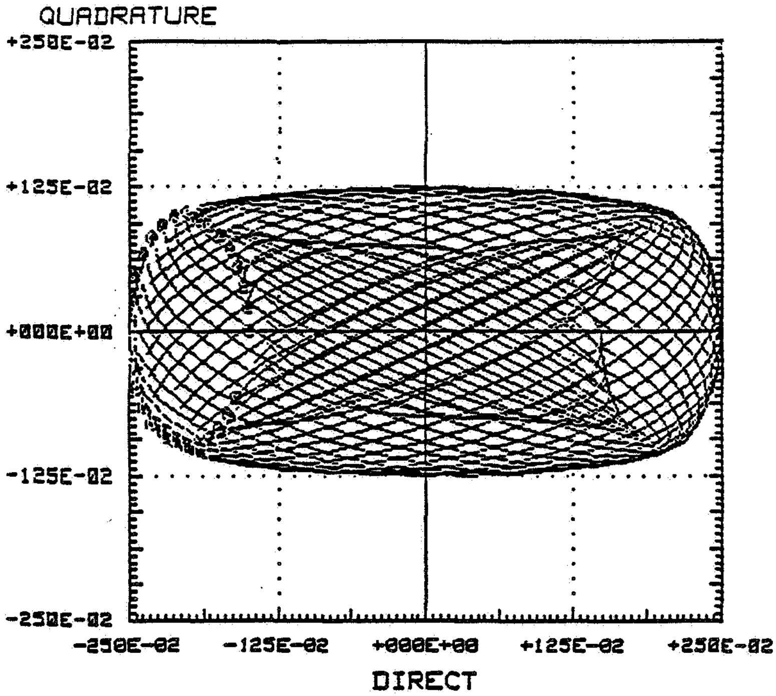

**** DATA ****

1.)	AX1	:	HORIZONTAL AMPLITUDE OF THE 1ST COMPONENT ***************	-2
2.)	AY1	:	VERTICAL AMPLITUDE OF THE 1ST COMPONENT *****************	-.25
3.)	AX2	:	HORIZONTAL AMPLITUDE OF THE 2ND COMPONENT ***************	.5
4.)	AY2	:	VERTICAL AMPLITUDE OF THE 2ND COMPONENT *****************	1
5.)	ALPX1	:	HORIZONTAL PHASE ANGLE OF THE 1ST COMPONENT [DEG] *******	0
6.)	ALPY1	:	VERTICAL PHASE ANGLE OF THE 1ST COMPONENT [DEG] *********	180
7.)	ALPX2	:	HORIZONTAL PHASE ANGLE OF THE 2ND COMPONENT [DEG] *******	0
8.)	ALPY2	:	VERTICAL PHASE ANGLE OF THE 2ND COMPONENT [DEG] *********	180
9.)	OME1	:	FREQUENCY OF THE 1ST COMPONENT [RAD/SEC] ****************	100
10.)	OME2	:	FREQUENCY OF THE 2ND COMPONENT [RAD/SEC] ****************	97
11.)	NMAX	:	NUMBER OF 'TIME'-STEPS **********************************	900

**** ROTOR ORBITAL MOTION ****

x=(Ax1)cos(omega1*t+alphax1)+(Ax2)cos(omega2*t+alphax2)

y=(Ay1)sin(omega1*t+alphay1)+(Ay2)sin(omega2*t+alphay2)

Figure 5. - Orbit simulating rotor instability.