CLAIMS:

1. A method for controlling the movement of a machine tool system (100) to machine a part (160), the method comprising the steps of:

receiving a machine configuration (208) corresponding to the machine tool system (100), the machine configuration (208) identifying a plurality of moveable axes (150, 152, 154, 156, 158) of the machine tool system (100) and a plurality of interdependencies therebetween;

generating based on the machine configuration (208) and a generalized kinematics library (210) a virtual kinematics machine (214);

receiving input data (204) corresponding to a shape of the part (160); and

generating positions for the plurality of moveable axes (150, 152, 154, 156, 158) of the machine tool system (100) based on the virtual kinematics machine (214) and the input data (204).

2. The method of claim 1, wherein the virtual kinematics machine (214) includes a plurality of virtual axes (250, 252, 254, 256, 258), the plurality of virtual axes (250, 252, 254, 256, 258) having a one-to-one correspondence to the plurality of moveable axes (150, 152, 154, 156, 158) of the machine tool system (100).

3. The method of claim 1, wherein the virtual kinematics machine is an instance of the generalized kinematics library (210).

4. The method of claim 1, further comprising the steps of:

providing the generated positions to a real time mill application (232); and

machining the part (160) with the real time mill (232).

5. The method of claim 4, further comprising the steps of:

generating based on the machine configuration (208) and the generalized kinematics library (210) a second virtual kinematics machine (234);

requesting position data of a moveable portion of the machine tool system (100) from the second virtual kinematics machine (234), the moveable portion being moved by the real time mill application (232); and

graphically representing the position data of the moveable portion on a display of the machine tool system (100).

6. The method of claim 5, wherein the moveable portion of the machine tool system (100) is a tool (141) and wherein the step of graphically representing the position data of the moveable

portion on the display of the machine tool system (100) includes displaying a representation of the tool moving relative to the part (160).

7. A method for controlling the movement of a machine tool system (100) having a plurality of moveable axes (150, 152, 154, 156, 158) to machine a part (160), the method comprising the steps of:

receiving input data (204) corresponding to a shape of the part (160);

generating a first virtual kinematics machine (214) based on a machine configuration (208) of the machine tool system (100) and a generalized kinematics library (210), the first virtual kinematics machine (214) generating positions for the plurality of moveable axes (150, 152, 154, 156, 158) of the machine tool system (100) based on the input data (204); and

generating a second virtual kinematics machine (234) based on the machine configuration (208) of the machine tool system (100) and the generalized kinematics library (210), the second virtual kinematics machine (234) generating position information for a moveable portion of the machine tool system (100).

8. The method of claim 7, wherein the moveable portion is a tool (141) and the position of the tool is moved based on the generated positions from the first virtual kinematics machine (214).

9. The method of claim 7, wherein the first virtual kinematics machine (214) and the second virtual kinematics machine (214) are instances of the generalized kinematics library (210).

10. A method of programming multiple machine tool systems (100) with a software controller (202), the method comprising the steps of:

providing a generalized kinematics library (210) accessible by the software controller (202);

generating a first virtual kinematics machine (214) having a first configuration corresponding to a first machine tool system, the first virtual kinematics machine (214) based on the generalized kinematics library (210); and

generating a second virtual kinematics machine (234) having a second configuration corresponding to a second machine tool system, the second virtual kinematics machine (234) based on the generalized kinematics library (210).

11. The method of claim 10, wherein the first virtual kinematics machine (214) and the second virtual kinematics machine (234) are both instances of the generalized kinematics library (210).

12. The method of claim 10, wherein the generalized kinematics library (210) is an object oriented library.

13. The method of claim 10, wherein the first machine tool system (100) is operably coupled to the software controller (202), the first machine tool system (100) having five orthogonal axes (150, 152, 154, 156, 158).

14. The method of claim 13, further comprising the steps of:

determining position information for the five orthogonal axes (150, 152, 154, 156, 158) of the first machine tool system (100) with the first virtual kinematics machine (214); and

controlling a real time mill application (232) operatively coupled to the five orthogonal axis based on the position information.

15. An apparatus for machining a part (160) with at least one tool, the apparatus comprising:

a frame (102);

a moveable support (104, 110, 120) supported by and moveable relative to the frame (102), the moveable support (104, 110, 120) supporting the part (160);

a machine tool spindle (138) supported by the frame (102) and moveable relative to the part (160), the machine tool spindle (138) adapted to couple the at least one tool (141), the moveable support (104, 110, 120) and the machine tool spindle (138) including a plurality of moveable axes (150, 152, 154, 156, 158); and

a motion control system (200) operably coupled to the machine tool spindle (138) and the moveable support (104, 110, 120), the motion control system (200) executing the machining of the part (160) through the controlled movement of the plurality of moveable axes (150, 152, 154, 156, 158) of the machine tool spindle (138) and the moveable support (104, 110, 120), wherein the controlled movement of the plurality moveable axes (150, 152, 154, 156, 158) is provided by an instance of a generalized kinematics library (210), the instance including a plurality of virtual axes (250, 252, 254, 256, 258) which correspond to the plurality of moveable axis (150, 152, 154, 156, 158).

16. The apparatus of claim 15, wherein plurality of moveable axes (150, 152, 154, 156, 158) includes five orthogonal axes.

17. The apparatus of claim 15, further comprising a user interface, the user interface being operably coupled to the motion control system (200), wherein the motion control system (200)

receives a shape of the part (160) through the user interface, the shape of the part (160) being included in a part program (204).

18. The apparatus of claim 15, further comprising a user interface, the user interface being operably coupled to the motion control system (200), wherein the motion control system (200) receives a shape of the part (160) through the user interface, the shape of the part (160) being provided through a conversational programming session.

19. The apparatus of claim 15, further comprising a user interface, the user interface being operably coupled to the motion control system (200), wherein a plurality of interdependencies between plurality of virtual axes (250, 252, 254, 256, 258) are provided through the user interface, the plurality of interdependencies describing the plurality of moveable axes (150, 152, 154, 156, 158) of the machine tool system (100).

20. The apparatus of claim 19, wherein the user interface includes a part kinematics order (356) and a tool kinematics order (358) and each of the plurality of virtual axes (250, 252, 254, 256, 258) are assigned to one of the part kinematics order (356) and the tool kinematics order (358), the plurality of interdependencies being determined based on an ordering of the virtual axes (250, 252, 254, 256, 258) in each of the part kinematics order (356) and the tool kinematics order (358).

21. The apparatus of claim 15, wherein the motion control system (200) further includes a second instance of the generalized kinematics library (210), the second instance being independent of the first instance.

22. The apparatus of claim 21, the second instance including a plurality of virtual axes (250, 252, 254, 256, 258) which correspond to the plurality of moveable axes (150, 152, 154, 156, 158).

23. The apparatus of claim 21, the second instance including a plurality of virtual axes which correspond to a second machine tool system.

24. A method of configuring a software controller (202) of a machine tool system (100), the method comprising the steps of:

providing a generalized kinematics library (210) accessible by the software controller (202);

receiving information regarding a configuration (208) of the machine tool system (100), the machine tool system (100) having a plurality of orthogonal moveable axes (150, 152, 154, 156, 158);

generating an instance of the generalized kinematics library (210) which corresponds to the machine tool system (100) based on the received information regarding the configuration of the machine tool system (100); and

controlling a movement of the plurality of orthogonal moveable axes (150, 152, 154, 156, 158) through the instance of the generalized kinematics library (210).

25. The method of claim 24, further comprising the steps of:

generating a second instance of the generalized kinematics library (210) which corresponds to the machine tool system (100) based on the received information regarding the configuration of the machine tool system (100), the second instance being independent of the instance; and

providing simulation graphics information through the second instance of the generalized kinematics library (210).

26. The method of claim 24, wherein the step of receiving information regarding the configuration of the machine tool system (100) includes the step of receiving through a user interface a plurality of interdependencies describing the plurality of orthogonal moveable axes of the machine tool system, each of the plurality of orthogonal moveable axes being assigned to one of a part kinematics order (356) and a tool kinematics order (358).

27. A computer readable medium having computer-executable instructions for controlling the movement of a plurality of moveable axes (150, 152, 154, 156, 158) of a machine tool system (100) to machine a part (160), said computer executable instructions comprising:

a generalized kinematics library (210);

instructions to generate an instance of the generalized kinematics library (210) based on a configuration of the machine tool system (100);

instructions to provide input data (204) to the instance of the generalized kinematics library (210); and

instructions to get output data from the generalized kinematics library (210), the output data being related to the movement of the plurality of moveable axes (150, 152, 154, 156, 158).

28. The computer readable medium of claim 27, further comprising

instructions to generate a second instance of the generalized kinematics library (210) based on the configuration of the machine tool system (100), the second instance being independent of the instance.

29. The computer readable medium of claim 27, wherein the instance of the generalized kinematics library (210) includes a part matrix stack (280) and a tool matrix stack (270).

30. The computer readable medium of claim 27, wherein a plurality of sub-matrices are implemented to analyze the part matrix stack (280) and the tool matrix stack (270).

CLAIMS:

1. A method for controlling the movement of a machine tool system to machine a part, the method comprising the steps of:

receiving a machine configuration corresponding to the machine tool system, the machine configuration identifying a plurality of moveable axes of the machine tool system and a plurality of interdependencies therebetween;

automatically self-configuring with a software controller a virtual kinematics machine based on the machine configuration and a generalized kinematics library, the virtual kinematics machine including a plurality of virtual axes, the plurality of virtual axes corresponding to the plurality of moveable axes identified in the machine configuration, the plurality of virtual axes being interrelated based on the plurality of interdependencies identified in the machine configuration; and

receiving input data corresponding to a shape of the part; wherein the virtual kinematics machine generates positions for the plurality of moveable axes of the machine tool system based on the input data.

2. The method of claim 1, wherein the virtual kinematics machine is an instance of the generalized kinematics library.

3. The method of claim 1, further comprising the steps of:

providing the generated positions to a real time mill application; and

machining the part with the real time mill.

4. The method of claim 1, wherein the generalized kinematics library includes a collection of objects from which at least one object is derived to develop the virtual kinematics machine.

5. The method of claim 1, wherein the step of automatically self-configuring with the software controller the virtual kinematics machine based on the machine configuration and the generalized kinematics library includes the steps of:

assembling a tool matrix stack and a part matrix stack, the tool matrix stack is a transformation from a spindle coordinate system to a machine reference coordinate system and the part matrix stack is a transformation from a workpiece coordinate system to the machine reference coordinate system.

6. The method of claim 1, wherein the step of receiving the machine configuration corresponding to the machine tool system includes the steps of:

receiving a part kinematics order list including a first portion of the plurality of moveable axes; and

receiving a tool kinematics order list including a second portion of the plurality of moveable axes, the part kinematics order list and the tool kinematics order list provides the software controller with the plurality of interdependencies of the plurality of moveable axes.

7. The method of claim 3, further comprising the steps of:

generating based on the machine configuration and the generalized kinematics library a second virtual kinematics machine;

requesting position data of a moveable portion of the machine tool system from the second virtual kinematics machine, the moveable portion being moved by the real time mill application; and

graphically representing the position data of the moveable portion on a display of the machine tool system.

8. The method of claim 7, wherein the moveable portion of the machine tool system is a tool and wherein the step of graphically representing the position data of the moveable portion on the display of the machine tool system includes displaying a representation of the tool moving relative to the part.

9. A method of programming multiple machine tool systems with a software controller, the method comprising the steps of:

providing a generalized kinematics library accessible by the software controller;

automatically self-configuring with the software controller a first virtual kinematics machine based on (1) a first machine configuration corresponding to a first machine tool system, and (2) the generalized kinematics library, the first virtual kinematics machine including a plurality of virtual axes being interrelated based on a plurality of interdependencies identified in the first machine configuration; and

automatically self-configuring with the software controller a second virtual kinematics machine based on (1) a second machine configuration corresponding to a

second machine tool system, and (2) the generalized kinematics library, the second virtual kinematics machine including a plurality of virtual axes being interrelated based on a plurality of interdependencies identified in the second machine configuration,

wherein the second machine configuration is different from the first machine configuration such that the second virtual kinematics machine has different kinematics than the first virtual kinematics machine.

10. The method of claim 9, wherein the first virtual kinematics machine and the second virtual kinematics machine are both instances of the generalized kinematics library.

11. The method of claim 9, wherein the generalized kinematics library is an object oriented library.

12. The method of claim 9, wherein the first machine tool system is operably coupled to the software controller, the first machine tool system having five orthogonal axes.

13. The method of claim 12, further comprising the steps of:

determining position information for the five orthogonal axes of the first machine tool system with the first virtual kinematics machine; and

controlling a real time mill application operatively coupled to the five orthogonal axes based on the position information.

14. A method of configuring a software controller of a machine tool system, the method comprising the steps of:

providing a generalized kinematics library accessible by the software controller;

receiving information regarding a configuration of the machine tool system, the configuration identifying a plurality of orthogonal moveable axes of the machine tool system and a plurality of interdependencies therebetween;

automatically self-configuring with the software controller an instance of the generalized kinematics library which corresponds to the machine tool system based on the received information regarding the configuration of the machine tool system; and

controlling a movement of the plurality of orthogonal moveable axes through the instance of the generalized kinematics library.

15. The method of claim 14, further comprising the steps of:

generating a second instance of the generalized kinematics library which corresponds to the machine tool system based on the received information regarding the configuration of the machine tool system, the second instance being independent of the first instance; and

providing simulation graphics information through the second instance of the generalized kinematics library.

16. The method of claim 14, wherein the step of receiving information regarding the configuration of the machine tool system includes the step of receiving through a user interface the plurality of interdependencies describing the plurality of orthogonal

moveable axes of the machine tool system, each of the plurality of orthogonal moveable axes being assigned to one of a part kinematics order and a tool kinematics order.