CLAIMS

What is claimed is:

~~1. A dual sided shot peening system (10) comprising:~~

~~a pressurized air supply (11) in pressurized air supply communication with independently controllable first and second shot peening air pressure regulators (12, 14),~~

~~the first and second shot peening air pressure regulators (12, 14) in pressurized air supply communication with first and second shot supplies (26, 28) respectively, and~~

~~independently controlled first and second shot flow control valves (16, 18) operably disposed between the first and second shot supplies (26, 28) and shot peening first and second nozzles (20, 22) respectively.~~

~~2. The system (10) as claimed in Claim 1, further comprising a computer (130) controllably connected to the first and second shot peening air pressure regulators (12, 14) and the first and second shot flow control valves (16, 18).~~

~~3. The system (10) as claimed in Claim 2, further comprising first and second nozzle supports (60, 62) supporting the first and second nozzles (20, 22) respectively and operable for fixedly or movably supporting the nozzles during shot peening.~~

~~4. The system (10) as claimed in Claim 3, further comprising the first and second nozzle supports (60, 62) being movable and operable to linearly move the first and second nozzles (20, 22) towards and away from each other and/or rotate or pivot the first and second nozzles (20, 22), and/or translate the first and second nozzles (20, 22) along first and second longitudinal axes (70, 72) in first and second lengthwise directions (74, 76), corresponding to first and second lengths (L1, L2) of the first and second nozzles (20, 22) respectively.~~

~~5. The system (10) as claimed in Claim 3, further comprising:~~

~~a manipulator (127) operable for supporting and moving a workpiece,~~

~~the manipulator (127) operable for positioning opposite sides of the workpiece between the first and second nozzles (20, 22) during shot peening by the first and second nozzles (20, 22), and~~

~~the computer (130) controllably connected to the manipulator (127).~~

~~6. The system (10) as claimed in Claim 5, further comprising first and second shot flow lines (54, 56) from the first and second shot flow control valves (16, 18) to the first and second nozzles (20, 22) and first and second booster lines (59, 61) from the first and second shot peening air pressure regulators (12, 14) to the first and second shot flow lines (54, 56) respectively.~~

~~7. The system (10) as claimed in Claim 5, further comprising the workpiece being a BLISK (8) with airfoils (34) supported by the manipulator (127) and the manipulator (127) operable for positioning opposite pressure and suction sides (46, 48) sides of the airfoils (34) between the first and second nozzles (20, 22) during shot peening by the first and second nozzles (20, 22).~~

~~8. The system (10) as claimed in Claim 7, further comprising first and second shot flow lines (54, 56) from the first and second shot flow control valves (16, 18) to the first and second nozzles (20, 22) and first and second booster lines (59, 61) from the first and second shot peening air pressure regulators (12, 14) to the first and second shot flow lines (54, 56) respectively.~~

~~9. The system (10) as claimed in Claim 6, further comprising the computer (130) operable to set different first and second intensities (I1, I2) of first and second streams (42, 44) from the first and second nozzles (20, 22) for simultaneously shot peening the pressure and suction sides (46, 48) sides respectively of the airfoils (34).~~

~~10. The system (10) as claimed in Claim 5, further comprising the computer (130) operable to set and vary different properties of first and second streams (42, 44) from the first~~

and second nozzles (20, 22) for simultaneously shot peening the pressure and suction sides (46, 48) sides respectively of the airfoils (34).

11. The system (10) as claimed in Claim 10, further comprising the properties selected from the group consisting of shot media flow rate, intensity, impingement angle (A) of media or shot stream exiting the nozzle with respect to a normal vector from an airfoil surface, distance (D1, D2) of a nozzle exit relative to the airfoil surface, and position of the nozzle relative to leading and/or trailing edges (LE, TE) of the airfoil (34), position of the nozzle relative to adjacent airfoils, and peen time.

12. A method for simultaneously shot peening first and second sides (46, 48) of a portion of a workpiece comprising:

shot peening with a dual sided shot peening system (10) including a pressurized air supply (11) in pressurized air supply communication with independently controllable first and second shot peening air pressure regulators (12, 14), the first and second shot peening air pressure regulators (12, 14) in pressurized air supply communication with first and second shot supplies (26, 28) respectively, and independently controlled first and second shot flow control valves (16, 18) operably disposed between the first and second shot supplies (26, 28) and shot peening first and second nozzles (20, 22) respectively;

supplying pressurized air from the pressurized air supply (11) to the first and second shot peening air pressure regulators (12, 14);

metering first and second shot media (50, 52) in first and second shot supplies (26, 28) into first and second streams (42, 44) of the first and second shot media (50, 52) by flowing pressurized air from the first and second shot peening air pressure regulators (12, 14) into the first and second shot supplies (26, 28) respectively;

flowing the first and second streams (42, 44) of the first and second shot media (50, 52) from the first and second shot supplies (26, 28) through individually or independently controlled first and second shot flow control valves (16, 18) respectively and independently regulating the first and second streams (42, 44) of the first and second shot media (50, 52) with the first and second shot flow control valves (16, 18) respectively;

~~flowing the first and second streams (42, 44) of the first and second shot media (50, 52) from the first and second shot flow control valves (16, 18) to the first and second nozzles (20, 22) respectively; and~~

~~shooting the first and second streams (42, 44) of the first and second shot media (50, 52) on the first and second sides (46, 48) respectively of the portion of the workpiece.~~

~~13. The method as claimed in Claim 12, further comprising controlling the first and second shot flow control valves (16, 18) to flow different amounts of the first and second streams (42, 44) of the first and second shot media (50, 52) and/or controlling the first and second shot peening air pressure regulators (12, 14) for flowing pressurized air to the first and second shot supplies (26, 28) at different pressures respectively.~~

~~14. The method as claimed in Claim 12, further comprising using the computer (130) to set and vary different properties of first and second streams (42, 44) from the first and second nozzles (20, 22) for simultaneously shot peening the first and second sides (46, 48) sides respectively.~~

~~15. A method for simultaneously shot peening airfoils (34) of a BLISK (8), the method comprising:~~

~~simultaneously shot peening opposite pressure and suction sides (46, 48) of the airfoils (34) with a dual sided shot peening system (10) including a pressurized air supply (11) in pressurized air supply communication with independently controllable first and second shot peening air pressure regulators (12, 14), the first and second shot peening air pressure regulators (12, 14) in pressurized air supply communication with first and second shot supplies (26, 28) respectively, and independently controlled first and second shot flow control valves (16, 18) operably disposed between the first and second shot supplies (26, 28) and shot peening first and second nozzles (20, 22) respectively;~~

~~supporting and moving the BLISK (8) with a manipulator (127) and using the manipulator (127) for positioning the airfoils (34) between the first and second nozzles (20, 22) during shot peening by the first and second nozzles (20, 22);~~

~~supplying pressurized air from the pressurized air supply (11) to the first and second shot peening air pressure regulators (12, 14);~~

~~metering first and second shot media (50, 52) in the first and second shot supplies (26, 28) into first and second streams (42, 44) of the first and second shot media (50, 52) by flowing pressurized air from the first and second shot peening air pressure regulators (12, 14) into the first and second shot supplies (26, 28) respectively;~~

~~flowing the first and second streams (42, 44) of the first and second shot media (50, 52) from the first and second shot supplies (26, 28) through individually or independently controlled first and second shot flow control valves (16, 18) respectively and independently regulating the first and second streams (42, 44) of the first and second shot media (50, 52) with the first and second shot flow control valves (16, 18) respectively;~~

~~flowing the first and second streams (42, 44) of the first and second shot media (50, 52) from the first and second shot flow control valves (16, 18) to the first and second nozzles (20, 22) respectively; and~~

~~shooting first and second streams (42, 44) of the first and second shot media (50, 52) on the pressure and suction sides (46, 48) respectively of the airfoils (34).~~

1. A dual sided shot peening system, comprising:

a workpiece, the workpiece being a BLISK with airfoils;

a computer;

a first shot peening air pressure regulator and a second shot peening air pressure regulator, the first and second shot peening air pressure regulators being coupled to the computer, the first and second shot peening air pressure regulators being separate and independently controllable by the computer;

a pressurized air supply in pressurized air supply communication with the first and second shot peening air pressure regulators,

a first shot supply and a second shot supply, the first and second shot peening air pressure regulators in pressurized air supply communication with the first and second shot supplies respectively,

a first nozzle and a second nozzle being separate and controlled independently of each other; and

a first shot flow control valve and a second shot flow control valve, the first and second shot flow control valves being coupled to the computer, the first and second shot flow control valves being separate and independently controllable by the computer, the first shot flow control valve operably disposed between the first shot supply and the first nozzle, and the second shot flow control valve operably disposed between the second shot supply and the second nozzle,

a manipulator configured for supporting the BLISK, the manipulator configured for positioning opposite pressure and suction sides of the airfoil between the first and second nozzles during shot peening by the first and second nozzles, and the computer controllably connected to the manipulator;

wherein the first nozzle defines a first stream during operation and wherein the second nozzle defines a second stream during operation, and wherein the computer is configured to set different first and second intensities of first and second streams from the first and second nozzles to provide different first and second coverage rates for simultaneously shot peening the pressure and suction sides respectively of the airfoils so as to manage movement of the airfoils during the shot peening.

2. The system as claimed in claim 1, further comprising first and second nozzle supports supporting the first and second nozzles respectively and configured for fixedly or movably supporting the nozzles during shot peening.

3. The system as claimed in claim 2, further comprising first and second shot flow lines from the first and second shot flow control valves to the first and second nozzles and first and second booster lines from the first and second shot peening air pressure regulators to the first and second shot flow lines respectively.

4. The system as claimed in claim 2, wherein the first nozzle defines a first longitudinal axis and a first lengthwise direction, wherein the second nozzle defines a second longitudinal axis and a second lengthwise direction, and wherein the system further comprises the first and second nozzle supports being movable and operable to linearly move the first and second nozzles towards and away from each other and/or rotate or pivot the first and second nozzles, and/or translate the first and second nozzles along the first and second longitudinal axes in the first and second lengthwise directions, corresponding to first and second lengths of the first and second nozzles respectively.

5. The system as claimed in claim 4, further comprising first and second shot flow lines from the first and second shot flow control valves to the first and second nozzles and first and second booster lines from the first and second shot peening air pressure regulators to the first and second shot flow lines respectively.

6. The system as claimed in claim 2, wherein the computer is configured to set and vary further properties of first and second streams from the first and second nozzles for simultaneously shot peening the pressure and suction sides respectively of the airfoils.

7. The system as claimed in claim 6, further comprising the further properties selected from the group consisting of shot media flow rate, impingement angle of media or shot stream exiting the nozzle with respect to a normal vector from an airfoil surface, distance of a nozzle exit relative to the airfoil surface, and position of the nozzle relative to leading and/or trailing edges of the airfoil, position of the nozzle relative to adjacent airfoils, and peen time.

8. The system as claimed in claim 6, further comprising first and second shot flow lines from the first and second shot flow control valves to the first and second nozzles and first and second booster lines from the first and second shot peening air pressure regulators to the first and second shot flow lines respectively.

9. The system as claimed in claim 1, wherein the first nozzle defines a first longitudinal axis and a first lengthwise direction, wherein the second nozzle defines a second longitudinal axis and a second lengthwise direction, and wherein the system further comprises first and second nozzles supports that translate the first and second nozzles along the first and second longitudinal axes in the first and second lengthwise directions, corresponding to first and second lengths of the first and second nozzles respectively.

10. The system as claimed in claim 1, wherein the first nozzle defines a first longitudinal axis and a first lengthwise direction, wherein the second nozzle defines a second longitudinal axis and a second lengthwise direction, and wherein the system further comprises first and second nozzle supports being movable and operable to linearly move the first and second nozzles towards and away from each other and rotate the first and second nozzles.

11. The system as claimed in claim 1, wherein the system further comprises first and second nozzle supports being independently movable and operable to linearly move the first and second nozzles towards and away from each other.

12. The system as claimed in claim 1, further comprising first and second shot flow lines from the first and second shot flow control valves to the first and second nozzles and first and second booster lines from the first and second shot peening air pressure regulators to the first and second shot flow lines respectively.

13. A method for simultaneously shot peening pressure and suction sides of a BLISK with airfoils comprising:

supporting and moving the BLISK with a manipulator and using the manipulator to position the airfoils between a first nozzle and a second nozzle during shot peening by the first and second nozzles,

shot peening with a dual sided shot peening system including a pressurized air supply in pressurized air supply communication with separate and independently controllable first and second shot peening air pressure regulators, the first and second shot peening air pressure regulators being coupled to a computer and in pressurized air supply communication with first and second shot supplies respectively, and separate and independently controlled first and second shot flow control valves being coupled to the computer and operably disposed between the first and second shot supplies and the first and second nozzles respectively, wherein shot peening comprises:

supplying pressurized air from the pressurized air supply to the first and second shot peening air pressure regulators;

metering first and second shot media in first and second shot supplies into first and second streams of the first and second shot media by flowing pressurized aft from the first and second shot peening air pressure regulators into the first and second shot supplies respectively;

flowing the first and second streams of the first and second shot media from the first and second shot supplies through individually or independently controlled first and second shot flow control valves respectively and independently regulating the first and second streams of the first and second shot media with the first and second shot flow control valves respectively;

flowing the first and second streams of the first and second shot media from the first and second shot flow control valves to the first and second nozzles respectively; and

shooting the first and second streams of the first and second shot media on the pressure and suction sides respectively of the airfoils,

wherein the first nozzle and second nozzle are separate and controlled independently of each other;

wherein the computer is configured to set different first and second intensities of the first and second streams from the first and second nozzles to provide different first and second coverage rates for simultaneously shot peening the pressure and suction sides respectively of the airfoils so as to manage movement of the airfoils during the shot peening.

14. The method as claimed in claim 13, further comprising controlling the first and second shot flow control valves to flow different amounts of the first and second streams of the first and second shot media and/or controlling the first and second shot peening air pressure regulators for flowing pressurized air to the first and second shot supplies at different pressures respectively.

15. The method as claimed in claim 14, further comprising flowing the first and second streams of the first and second shot media from the first and second shot flow control valves through first and second shot flow lines to the first and second nozzles respectively and flowing pressurized air from the first and second shot peening air pressure regulators through first and second booster lines to the first and second shot flow lines respectively.

16. The method as claimed in claim 13, further comprising using the computer to set and vary further properties of first and second streams from the first and second nozzles for simultaneously shot peening the pressure and suction sides respectively.

17. The method as claimed in claim 16, further comprising the further properties selected from the group consisting of shot media flow rate, impingement angle of media or shot stream exiting the nozzle with respect to a normal vector from an airfoil surface, distance of a nozzle exit relative to the pressure and suction sides, position of the nozzle relative to leading and/or trailing edges of a portion, position of the nozzle relative to adjacent portions, and peen time.

18. The method as claimed in claim 16, further comprising flowing pressurized air through first and second shot flow lines from the first and second shot flow control valves to the first and second nozzles and first and second booster lines from the first and second shot peening air pressure regulators to the first and second shot flow lines respectively.

19. The method as claimed in claim 13, further comprising supporting and independently moving the first and second nozzles during the peening with first and second nozzle supports respectively of the system, moving the first and second nozzles linearly towards and away from each other and/or rotating or pivoting the first and second nozzles, and/or translating the first and second nozzles along first and second longitudinal axes in first and second lengthwise directions, corresponding to first and second lengths of the first and second nozzles respectively.

20. The method as claimed in claim 13, further comprising moving the manipulator to move first and second streams from the first and second nozzles in a serpentine pattern including one or more U-shaped first portions.