CLAIMS:

1. A beam controller, characterized in comprising: an optical phased array, a free-space beam combining area, and a shared grating transmitter, wherein the optical phased array comprises: a beam splitter and a waveguide array coupled to the beam splitter,

the beam splitter is configured to: equally split an initial light beam into a plurality of sub-beams,

the waveguide array comprises: a plurality of waveguides arranged in one-to-one correspondence to the sub-beams, and the waveguides are configured to receive and transmit the sub-beams,

transmission tail sections of the plurality of waveguides are concentrated in the free-space beam combining area in a fan shape manner, and the free-space beam combining area is configured to: enable the plurality of sub-beams to be combined on an image plane,

the shared grating transmitter, comprising a plurality of arc-shaped teeth with a same curvature center, is configured to diffract and transmit a combined light beam formed by the plurality of sub-beams combined on the image plane, wherein the image plane is located in an area surrounded by the plurality of arc-shaped teeth and the curvature center.

2. The beam controller according to claim 1, characterized in that

an orthographic projection shape of the image plane on a reference plane comprises: an arc with a curvature radius of R,

an orthographic projection shape of the free-space beam combining area on the reference plane comprises: a Rowland circle with a radius of 2R, and a center of the Rowland circle is located on the arc.

3. The beam controller according to claim 1, characterized in that a distance between output ends of adjacent two of the waveguides is less than a wavelength of the initial light beam.

4. The beam controller according to claim 3, characterized in that each distance between the

output ends of adjacent two of the waveguides is equal.

5. The beam controller according to claim 1, characterized in that a product of a difference in transmission distance between adjacent two of the waveguides and a group index of refraction of the waveguides is an integer multiple of a wavelength of the initial light beam.

6. The beam controller according to claim 1, characterized in that the beam splitter comprises a star coupler, and each of the waveguides comprises a transmission head section, a transmission middle section, and the transmission tail section connected in sequence,

the transmission head sections of the plurality of waveguides are concentrated on the star coupler in a fan shape manner,

the transmission middle sections of the plurality of waveguides are arranged in parallel, and a distance between adjacent two of the transmission middle sections is greater than a first threshold.

7. The beam controller according to claim 1, characterized in that the beam splitter comprises a plurality of 1×2 cascaded waveguide beam splitters,

each of the waveguides comprises a transmission head section and the transmission tail section connected in sequence, the transmission head sections of the plurality of waveguides are arranged in parallel, and a distance between adjacent two of the transmission head sections is greater than a second threshold.

8. The beam controller according to claim 1, characterized in that the waveguide array further comprises: a controllable phase shifter integrated on each of the waveguides, and the controllable phase shifter is configured to control a phase of the sub-beam.

9. The beam controller according to claim 8, characterized in that

the controllable phase shifter comprises: a metal heating layer arranged on each of the waveguides, or

each of the waveguides is a doped waveguide, and the controllable phase shifter comprises:

a metal electrode connected to the doped waveguide.

10. The beam controller according to claim 1, characterized in that the waveguide array further comprises: a variable optical attenuator integrated in each of the waveguides, and the variable optical attenuator is configured to adjust transmission power of the waveguide.

11. A beam controlling method, characterized in comprising:

equally splitting an initial light beam into a plurality of sub-beams and correspondingly transmitting one sub-beam to one waveguide by a beam splitter;

respectively transmitting, by a plurality of the waveguides, the corresponding sub-beams to a free-space beam combining area;

combining the plurality of sub-beams on an image plane in the free-space beam combining area; and

diffracting and transmitting, by a shared grating transmitter comprising a plurality of arc-shaped teeth with a same curvature center, a combined light beam formed by the plurality of sub-beams combined on the image plane,

wherein the image plane is located in an area surrounded by the plurality of arc-shaped teeth and the curvature center.

12. The beam controlling method according to claim 11, characterized in that the beam controlling method further comprises:

adjusting a wavelength of the initial beam, so that a scanning angle of the combined light beam changes in a first direction; and

adjusting phases of the sub-beams, so that the scanning angle of the combined light beam changes in a second direction,

the first direction and the second direction are orthogonal to each other.