APPENDIX A Settlement of the design variables on the medial axis

To get the distributions of the medial axis $(z(r),r)$ in engineering, the mathematical function $z(r)$ can be got through fitting and interpolation with code. The main methods can be concluded as:

(1) Matlab code for the calculation of $z(r), z'(r), F(r)$ on the medial axis:

RR=importdata('r.txt');%%%%%%%%%%%%%import the prescribed radial coordinate on the medial axis (scattered dots);

ZZ=importdata('z(r).txt');%%%%%%%%%%%%%%import the prescribed axial coordinate on the medial axis;

F=importdata('F(r).txt');%%%%%%%%%%%%%%import the prescribed cross section area;

z0=interp1(RR,ZZ,r0,'cubic');%%%%%%%%%%calculate $z(r)$;

z(r)pie=gradient(z0)./gradient(r0);%%%%%%%%%%calculate the derivative $z'(r)$;

F0=interp1(RR,ZZ,r0,'cubic');%%%%%%%%calculate $F(r)$;

(2) For the distribution of scattered dots on medial axis, it could be got with the related methods as follows:

Example1. If the distribution of the inclined angle $\theta(t)$ in the medial axis is given at first, the medial axis can be settled as:

$$\begin{cases} z = z_0 + \int_0^t \cos\theta(t)dt \\ r = r_0 + \int_0^t \sin\theta(t)dt \end{cases}$$

Example2. As shown in Fig S. , the crucial points A,B,C,D on the medial axis could be got from the preliminary design requirement and 1-D design theory. With the calculated coordinates A,B,C,D on the medial axis, the relationships between the radial coordinate and the axial coordinate could be interpolated and expressed with polynomial. Therefore, $z(r),z'(r)$ can also be settled down.

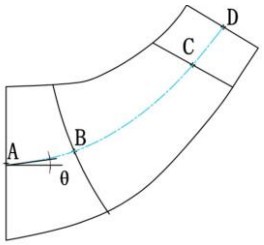

Fig S. 1 Sketch presentation of the meridional profile