**Supplementary Material**

**Finite Element Modeling of Nanoindentation Response of Elastic Fiber-Matrix Composites**

Pengfei Duan, Yuqing Xia, Steve Bull and Jinju Chen a)
*School of Engineering, Newcastle University, Newcastle upon Tyne, NE1 7RU, UK*a) E-mail: Jinju.chen@ncl.ac.uk

![D:\PhD\Conference & Publication\[paper]2017E_fibre_indentation location\JMR\FIG. S1.tif]()

FIG. S1. Finite element mesh for (a) the vertical fiber model and (b) the horizontal fiber model in the case of *d/r=2*, indented by the conical indenter.

![D:\PhD\Conference & Publication\[paper]2017E_fibre_indentation location\JMR\FIG. S2.tif]()

FIG. S2. Finite element mesh for the vertical fiber model in the case of *d/r=2*, indented by the Berkovich indenter with two different orientations. That is, (a) the pyramid flat faces toward the fiber and (b) the pyramid edge faces toward the fiber.

![D:\PhD\Conference & Publication\[paper]2017E_fibre_indentation location\JMR\FIG. S3.tif]()

FIG. S3. Loading-unloading procedure.

TABLE SI. Fitting parameters of the linear equation (Equation (5)) for the vertical fiber model.

|  |  |
| --- | --- |
|  | Linear equation (Equation (5)) |
| $$d/r$$ | 0 | 0.5 | 0.75 | 1 | 1.5 | 2 | 3 | 5 |
| $$A$$ | -7.2395 | -6.5031 | -5.0088 | -2.1913 | 4.0865 | 1.6576 | 0.7217 | 0.6005 |
| $$C$$ | 8.9642 | 8.5582 | 7.3889 | 5.6086 | 1.9314 | 2.0072 | 2.1493 | 2.1542 |
| $$R^{2}$$ | 0.9835 | 0.9774 | 0.9605 | 0.9730 | 0.9546 | 0.9604 | 0.9893 | 0.9902 |

TABLE SII. Fitting parameters of the polynomial equation (Equation (6)) for the vertical fiber model.

|  |  |
| --- | --- |
|  | Polynomial equation (Equation (6)) |
| $$d/r$$ | 0 | 0.5 | 0.75 | 1 | 1.5 | 2 | 3 | 5 |
| $$A$$ | 10.720 | 11.322 | 11.524 | 4.1705 | -10.003 | 3.7843 | 0.8581 | 0.6852 |
| $$B$$ | -14.744 | -14.429 | -13.075 | -5.1106 | 11.089 | -0.9914 | 0.1210 | 0.1208 |
| $$C$$ | 10.170 | 9.8320 | 8.6853 | 6.0778 | 0.8061 | 2.4329 | 2.2459 | 2.2313 |
| $$R^{2}$$ | 0.9997 | 0.9996 | 0.9986 | 0.9995 | 0.9975 | 0.9979 | 0.9998 | 0.9999 |

TABLE SIII. Fitting parameters of the linear equation (Equation (5)) for the horizontal fiber model.

|  |  |
| --- | --- |
|  | Linear equation (Equation (5)) |
| $$d/r$$ | 0 | 0.5 | 2 | 3 | 4 | 5 |
| $$A$$ | -6.5054 | -6.9854 | 2.0401 | 1.3816 | 1.0472 | 0.9328 |
| $$C$$ | 6.8331 | 7.8845 | 2.2908 | 2.0819 | 2.0829 | 2.0796 |
| $$R^{2}$$ | 0.9663 | 0.9761 | 0.9683 | 0.9987 | 0.9963 | 0.9966 |

TABLE SIV. Fitting parameters of the polynomial equation (Equation (6)) for the horizontal fiber model.

|  |  |  |
| --- | --- | --- |
|  |  | Polynomial equation (Equation (6)) |
| $$d/r$$ | 0 | 0.5 | 2 | 3 | 4 | 5 |
| $$A$$ | 13.852 | 12.492 | -3.9879 | 0.5734 | 0.7300 | 0.6275 |
| $$B$$ | -16.202 | -15.730 | 4.8316 | 0.9802 | 0.5362 | 0.4935 |
| $$C$$ | 8.3915 | 9.2898 | 1.8422 | 2.1464 | 2.1650 | 2.1501 |
| $$R^{2}$$ | 0.9991 | 0.9996 | 0.9960 | 0.9999 | 0.9999 | 0.9999 |