

**ma00aa**

Calculates volume integrals of Chebyshev polynomials and metric element products.

[called by: [dforce.](#)][calls: [metrix.](#)]**contents**

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**1.1 chebyshev-metric information**

1. The following quantities are calculated:

$$\text{DToocc}(l, p, i, j) \equiv \int ds \bar{T}'_{l,i} \bar{T}_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \cos \alpha_j \quad (1)$$

$$\text{DToocs}(l, p, i, j) \equiv \int ds \bar{T}'_{l,i} \bar{T}_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \sin \alpha_j \quad (2)$$

$$\text{DToosc}(l, p, i, j) \equiv \int ds \bar{T}'_{l,i} \bar{T}_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \cos \alpha_j \quad (3)$$

$$\text{DTooss}(l, p, i, j) \equiv \int ds \bar{T}'_{l,i} \bar{T}_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \sin \alpha_j \quad (4)$$

$$\text{TTsscc}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \cos \alpha_j \bar{g}_{ss} \quad (5)$$

$$\text{TTsscs}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \sin \alpha_j \bar{g}_{ss} \quad (6)$$

$$\text{TTsssc}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \cos \alpha_j \bar{g}_{ss} \quad (7)$$

$$\text{TTssss}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \sin \alpha_j \bar{g}_{ss} \quad (8)$$

$$\text{TDstcc}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \cos \alpha_j \bar{g}_{s\theta} \quad (9)$$

$$\text{TDstcs}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \sin \alpha_j \bar{g}_{s\theta} \quad (10)$$

$$\text{TDstsc}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \cos \alpha_j \bar{g}_{s\theta} \quad (11)$$

$$\text{TDstss}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \sin \alpha_j \bar{g}_{s\theta} \quad (12)$$

$$\text{TDstcc}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \cos \alpha_j \bar{g}_{s\zeta} \quad (13)$$

$$\text{TDstcs}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \sin \alpha_j \bar{g}_{s\zeta} \quad (14)$$

$$\text{TDstsc}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \cos \alpha_j \bar{g}_{s\zeta} \quad (15)$$

$$\text{TDstss}(l, p, i, j) \equiv \int ds \bar{T}_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \sin \alpha_j \bar{g}_{s\zeta} \quad (16)$$

$$\text{DDstcc}(l, p, i, j) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \cos \alpha_j \bar{g}_{\theta\theta} \quad (17)$$

$$\text{DDstcs}(l, p, i, j) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \sin \alpha_j \bar{g}_{\theta\theta} \quad (18)$$

$$\text{DDstsc}(l, p, i, j) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \cos \alpha_j \bar{g}_{\theta\theta} \quad (19)$$

$$\text{DDstss}(l, p, i, j) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \sin \alpha_j \bar{g}_{\theta\theta} \quad (20)$$

$$\text{DDstcc}(\mathbf{l}, \mathbf{p}, \mathbf{i}, \mathbf{j}) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \cos \alpha_j \bar{g}_{\theta\zeta} \quad (21)$$

$$\text{DDstcs}(\mathbf{l}, \mathbf{p}, \mathbf{i}, \mathbf{j}) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \sin \alpha_j \bar{g}_{\theta\zeta} \quad (22)$$

$$\text{DDstsc}(\mathbf{l}, \mathbf{p}, \mathbf{i}, \mathbf{j}) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \cos \alpha_j \bar{g}_{\theta\zeta} \quad (23)$$

$$\text{DDstss}(\mathbf{l}, \mathbf{p}, \mathbf{i}, \mathbf{j}) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \sin \alpha_j \bar{g}_{\theta\zeta} \quad (24)$$

$$\text{DDstcc}(\mathbf{l}, \mathbf{p}, \mathbf{i}, \mathbf{j}) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \cos \alpha_j \bar{g}_{\zeta\zeta} \quad (25)$$

$$\text{DDstcs}(\mathbf{l}, \mathbf{p}, \mathbf{i}, \mathbf{j}) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \cos \alpha_i \sin \alpha_j \bar{g}_{\zeta\zeta} \quad (26)$$

$$\text{DDstsc}(\mathbf{l}, \mathbf{p}, \mathbf{i}, \mathbf{j}) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \cos \alpha_j \bar{g}_{\zeta\zeta} \quad (27)$$

$$\text{DDstss}(\mathbf{l}, \mathbf{p}, \mathbf{i}, \mathbf{j}) \equiv \int ds \bar{T}'_{l,i} \bar{T}'_{p,j} \oint \oint d\theta d\zeta \sin \alpha_i \sin \alpha_j \bar{g}_{\zeta\zeta} \quad (28)$$

where  $\bar{T}_{l,i} \equiv T_l \bar{s}^{m_i/2}$  if the domain includes the coordinate singularity, and  $\bar{T}_{l,i} \equiv T_l$  if not; and  $\bar{g}_{\mu\nu} \equiv g_{\mu\nu}/\sqrt{g}$ .

2. The double-angle formulae are used to reduce the above expressions to the Fourier harmonics of  $\bar{g}_{\mu\nu}$ : see `kija` and `kijS`, which are defined in [preset](#).