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The buckling sphere – theory and algorithmic implementation of a new concept for classification of loss of stability

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The surface of the buckling sphere contains a curve which represents the track of a non-uniformly moving particle. Its instantaneous position is the one of the endpoint of a moving eigenvector $\mathbf{v}_1^*(\varphi(\lambda),\theta(\lambda))$, $\left|\mathbf{v}_1^*\right|=1$, where $\varphi(\lambda)$ and $\theta(\lambda)$ denote the azimuth and the zenith angle, respectively, both depending on the load parameter λ that plays the role of the time. $\mathbf{v}_1^*$ and $\lambda_1^*(\lambda)-\lambda$ represent the first eigenpair of the consistently linearized eigenproblem. $\theta(\lambda)$ is related to the percentage bending energy of the total strain energy. $\varphi(\lambda)$ allows splitting up the percentage membrane energy into a part due to stretching and one due to rotations of tangents. After presentation of the theory and of its algorithmic translation, the concept will be first applied to the general case involving both membrane and non-membrane action in the prebuckling regime and then to the limiting cases of buckling from a membrane stress state and from a state of pure bending (lateral torsional buckling).

Keywords: loss of stability, spherical geometry, consistently linearized eigenproblem, percentage bending energy, buckling from membrane stress state, lateral torsional buckling