# ABOUT MATERIAL REPOSITORY

## Input File Formatting

## Material Categorization

### Elastomers

1. **Natural Rubber (NR)**
2. **Synthetic Rubbers**
   * *Hydrocarbon-Based*: SBR, BR, EPDM, IIR.
   * *Polar Rubbers*: NBR, CR.
   * *Specialty Synthetics*: FKM, ACM.
3. **Silicone Rubbers (Q)**
4. **Polyurethanes (PU)**
   * Thermoset PU.
5. **Thermoplastic Elastomers (TPE)**
   * TPO, TPV, SBS, SEBS, *and* Thermoplastic PU (TPU).
6. **Others/Hybrid/Specialty Elastomers**
   * TPSiV, Bio-Based Rubbers.

### Foams

1. **Polymeric Open-Cell Foams**
2. **Polymeric Closed-Cell Foams**
3. **Others**

### Soft Biological Tissues

1. **Human**
2. **Animal**
3. **Others**

### Gels & Hydrogels

1. **Natural Polymer-Based** 
   * Collagen gels
   * Fibrin gels
   * Alginate hydrogels
   * Hyaluronic acid (HA) hydrogels
2. **Synthetic Polymer-Based**
   * PEG hydrogels
   * PAAm (Polyacrylamide) gels
   * PVA (Polyvinyl alcohol) hydrogels
3. **Composite/Hybrid**
   * Collagen-PEG hybrids
   * Nanocellulose-reinforced hydrogels
4. **Others**

# Hyperelastic models

## Pure Deformation Modes Expressions

### Invariant-Based Models

#### Uniaxial

#### Biaxial

#### Pure Shear

#### Simple Shear

### Stretch-Based Models

#### Uniaxial

#### Biaxial

#### Pure Shear

#### Simple Shear

### Hookean-type Models

#### Uniaxial

#### Biaxial

#### Pure Shear

#### Simple Shear

## Literature Review of Hyperelastic Models

### Phenomenological Models

#### Stretch-Based Models

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| --- | --- |
| **Model Name**: Valanis-Landel | **Source**: (Valanis; Landel, 1967) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Peng-Landel | **Source**: (Peng; Landel, 1972) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Ogden | **Source**: (Ogden, 1972) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Attard | **Source**: (Attard; Hunt, 2004) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Shariff | **Source**: (Shariff, 2000) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Arman-Narooei | **Source**: (Narooei; Arman, 2018) |
| **Equation**: | |
| **Parameters**: | |

#### Invariant-Based Models

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| **Model Name**: Mooney-Rivlin | **Source**: (Mooney, 1940) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Neo-Hookean | **Source**: (Treloar, 1943b) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Isihara | **Source**: (Isihara; Hashitsume; Tatibana, 1951) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Biderman | **Source**: (Biderman, 1958) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: James-Green-Simpson | **Source**: (James; Green; Simpson, 1975) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: James-Green-Simpson | **Source**: (Haines; Wilson, 1979) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Yeoh | **Source**: (Yeoh, 1990) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Lion | **Source**: (Lion, 1997) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Haupt-Sedlan | **Source**: (Haupt; Sedlan, 2001) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Hartmann-Neff | **Source**: (Hartmann; Neff, 2003) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Carroll | **Source**: (Carroll, 2011) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Nunes | **Source**: (Nunes, 2011) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Bahreman-Darijani | **Source**: (Bahreman; Darijani, 2015) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Zhao | **Source**: (Zhao; Mu; Du, 2019) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Arnoux | **Source**: (Arnoux, 2000; Arnoux et al., 2002) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Warner | **Source**: (Warner, 1972) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Kilian | **Source**: (Kilian, 1981) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Van der Waals | **Source**: (Kilian, 1980) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Gent | **Source**: (Gent, 1996) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Takamizawa-Hayashi | **Source**: (Takamizawa; Hayashi, 1987) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Yeoh-Fleming | **Source**: (Yeoh; Fleming, 1997) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: 3 Parameters Gent | **Source**: (Gent, 1999) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Pucci-Saccomandi | **Source**: (Pucci; Saccomandi, 2002) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Horgan-Saccomandi | **Source**: (Horgan; Saccomandi, 2004) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Beatty | **Source**: (Beatty, 2008) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Horgan-Murphy | **Source**: (Horgan; Murphy, 2007) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: bin Othman & Gregory | **Source**: (Othman; Gregory, 1990) |
| **Equation**: | |
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| **Model Name**: Knowles | **Source**: (Knowles, 1977) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Swanson | **Source**: (Swanson, 1985) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Yamashita-Kawabata | **Source**: (Yamashita; Kawabata, 1992) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Davis-De-Thomas | **Source**: (Davies; De; Thomas, 1994) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Gregory | **Source**: (Gregory; Muhr; Stephens, 1997) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: modified Gregory | **Source**: (He et al., 2022) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: modified Gregory | **Source**: (He et al., 2022) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Beda | **Source**: (Beda, 2005) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Amin | **Source**: (Amin et al., 2006) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Lopez-Pamies | **Source**: (Lopez-Pamies, 2010) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: gen-Yeoh | **Source**: (Hohenberger et al., 2019) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Hart-Smith | **Source**: (Hart-Smith, 1966) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Veronda-Westmann | **Source**: (Veronda; Westmann, 1970) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Fung-Demiray | **Source**: (Demiray, 1972; Fung, 1967) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Vito | **Source**: (Vito, 1973) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Humphrey-Yin | **Source**: (Humphrey; Yin, 1987) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: modified Yeoh | **Source**: (Yeoh, 1993) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Martins | **Source**: (Martins et al., 1998) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Chevalier-Marco | **Source**: (Gornet et al., 2012) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Mansouri-Darijani | **Source**: (Mansouri; Darijani, 2014) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Gent-Thomas | **Source**: (Gent; Thomas, 1958) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Alexander | **Source**: (Alexander, 1968) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Lambert Diani-Rey | **Source**: (Lambert-Diani; Rey, 1999) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Hoss-Marczak-I | **Source**: (Hoss; Marczak, 2010) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Hoss-Marczak-II | **Source**: (Hoss; Marczak, 2010) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Exp-Ln | **Source**: (Khajehsaeid; Arghavani; Naghdabadi, 2013) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: modified Demiray | **Source**: (Demiray et al., 1988) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Holmes-Mow | **Source**: (Holmes; Mow, 1990) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Raghavan-Vorp | **Source**: (Raghavan; Vorp, 2000) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Singh | **Source**: (Singh; Katiyar; Singh, 2013) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Tang | **Source**: (Tang et al., 2009) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: van Dam | **Source**: (Van Dam et al., 2008) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: modified exp-ln | **Source**: (Dwivedi et al., 2022) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Fu | **Source**: (Van Dam et al., 2008) |
| **Equation**: | |
| **Parameters**: | |

#### Mixed Phenomenological Model

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| **Model Name**: Continuum Hybrid | **Source**: (Beda; Chevalier, 2003) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Bechir-4term | **Source**: (Bechir et al., 2006) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: WFB | **Source**: (Korba; Barkey, 2017) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Volokh-Vorp | **Source**: (Volokh; Vorp, 2008) |
| **Equation**: | |
| **Parameters**: | |

### Micromechanical Network Models

#### Gaussian Chain Network Models

|  |  |
| --- | --- |
| **Model Name**: Gaussian | **Source**: (Treloar, 1943a) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Affine | **Source**: (Flory, 1976; Kuhn, 1946; Wall; Flory, 1951) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Phantom | **Source**: (Flory, 1976; Kuhn, 1946; Wall; Flory, 1951) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Edwards-Tube | **Source**: (Edwards, 1967) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Slip-Link | **Source**: (Ball et al., 1981) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Constrained Junctions | **Source**: (Erman; Flory, 1982; Flory; Erman, 1982) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Edwards-Vilgis | **Source**: (Edwards; Vilgis, 1986) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: MCC | **Source**: (Erman; Monnerie, 1989) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Tube | **Source**: (Heinrich; Kaliske, 1997) |
| **Equation**: | |
| **Parameters**: | |

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| --- | --- |
| **Model Name**: Nonaffine-Tube | **Source**: (Rubinstein; Panyukov, 1997) |
| **Equation**: | |
| **Parameters**: | |

#### Non-Gaussian Chain Network Models

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| --- | --- |
| **Model Name**: Three-Chain | **Source**: (James; Guth, 1943) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Four-Chain | **Source**: (Flory, 1944) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Arruda-Boyce | **Source**: (Arruda; Boyce, 1993; Cohen, 1991) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: modified Flory-Erman | **Source**: (Boyce; Arruda, 2000; Edwards, 1967) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Extended-Tube | **Source**: (Kaliske; Heinrich, 1999) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Meissner-Matějka | **Source**: (Meissner; Matějka, 2003, 2004) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Micro-Sphere | **Source**: (Miehe; Göktepe; Lulei, 2004) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Bootstrapped-8-Chain | **Source**: (Miroshnychenko; Green, 2009; Miroshnychenko; Green; Turner, 2005) |
| **Equation**: | |
| **Parameters**: | |

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| --- | --- |
| **Model Name**: Davidson-Goulbourne | **Source**: (Davidson; Goulbourne, 2013) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Network Averaging Tube | **Source**: (Khiêm; Itskov, 2016) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: SpT | **Source**: (Xiang et al., 2018) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Dobrynin & Carrillo | **Source**: (Dobrynin; Carrillo, 2011) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Simplified Tube | **Source**: (Plagge et al., 2020) |
| **Equation**: | |
| **Parameters**: | |

#### Mixed Micromechanical Network Models

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| --- | --- |
| **Model Name**: Wu-Giessen (Full Network) | **Source**: (Treloar; Riding, 1997; Wu; Van der Giessen, 1992; Wu; Van Der Giessen, 1993) |
| **Equation**: | |
| **Parameters**: | |

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| --- | --- |
| **Model Name**: Zuniga-Beatty | **Source**: (Elı́as-Zúñiga; Beatty, 2002) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Lim | **Source**: (Elı́as-Zúñiga; Beatty, 2002) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Lim | **Source**: (Lim, *[S.d.]*) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Bechir-Chevalier | **Source**: (Bechir; Chevalier; Idjeri, 2010) |
| **Equation**: | |
| **Parameters**: | |

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| **Model Name**: Davies | **Source**: (Bechir; Chevalier; Idjeri, 2010) |
| **Equation**: | |
| **Parameters**: | |

### Hookean-type Models

Every Hookean-type hyperelastic model have mechanical behavior intrinsically linked to the used strain measure. The linear relationship between the conjugated pair of stress and strain, as well as the Strain Energy Function the represent the hyperelastic model are presented below. As one can see, every Hookean-type model has at least two material parameters: Young’s modulus () and Poisson’s ratio (), which are used to define the Lamé Parameters ( and ), so any other parameter necessary to define the strain measure is added to those two.

|  |  |
| --- | --- |
| **Strain Measure**: Generalized Hyperbolic-Sine (GHS) | **Source**: (Peixoto, 2024; Peixoto; Greco; Vasconcellos, 2024) |
| **Equation**:  \* and can be any given strain measure in its uniaxial and multiaxial format, respectively. | |
| **Parameters**: | |

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| **Strain Measure**: Seth-Hill (Doyle-Ericken or Classical) | **Source:**  (Doyle; Ericksen, 1956; Hill, 1968; Seth, 1961) |
| **Equation**: | |
| **Parameters**: | |

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| **Strain Measure**: GHS–Seth-Hill | **Source**: (Peixoto, 2024; Peixoto; Greco; Vasconcellos, 2024) |
| **Equation**: | |
| **Parameters**: | |

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| **Strain Measure**: Curnier-Zysset Metric Family | **Source**: (Curnier; Zysset, 2006) |
| **Equation**: | |
| **Parameters**: | |

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| --- | --- |
| **Strain Measure**: Curnier-Rakotomanana Family (Darijani-Naghdabadi Power Family) | **Source**: (Curnier; Rakotomanana, 1991; Darijani; Naghdabadi, 2013) |
| **Equation**: | |
| **Parameters**: | |

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| **Strain Measure**: Darijani-Naghdabadi Exponencial Family | **Source**: (Darijani; Naghdabadi, 2013) |
| **Equation**: | |
| **Parameters**: | |

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| **Strain Measure**: Beex Family | **Source**: (Beex, 2019) |
| **Equation**:  \*is a set*:* and are the Seth-Hill strain measures. | |
| **Parameters**: | |

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