The study of workspace is essential for the optimal placement of the work piece and achieving high

manipulator dexterity [28]. The workspace is also an important criterion for comparing manipulator structures

[9]; it can be thought of as a global measure. Many researchers have used the manipulator workspace as an important performance index [9, 29] to optimize manipulator structure

* Dexterity Measures: Even for the sense of dexterity as local kinematic accuracy, a number of mathematical measures have been proposed for quantification (Klein 1985). The four measures to be examined here are the determinant, condition number, ~~minimum singular value, and joint range availability~~. (Klein and Blaho 87)

1. Manipulability index -- – for no redundant manipulators where J is the jacobian – bigger is better
2. **Local Conditioning Index** LCI - [0< LCI<1] 🡪 1 is the best

1. ~~minimum singular value -~~

* **Indices for Joint Mid-Range Proximity :**
* **Isotropic Index** Kim and Khosla [70] proposed a measure to quantify the isotropy of the manipulator ellipsoid. The Isotropic Index (*)* is defined as the ratio of the geometric mean to the arithmetic mean of the Eigenvalues.

where is *ψ* the arithmetic mean of the Eigenvalues and *μO* is the order independent manipulability index.

is upper bound at one. A larger isotropic index means a more isotropic ellipsoid. When all the Eigenvalues

are the same the Isotropic Index is one, and the manipulator ellipsoid is completely isotropic. The Isotropic Index is a local performance metric