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# 2D Graphical Optimization for Molecular Effect Model in High Temperature Superconductors Thallium Class [ $T_C < 0°$ , $T_C > 0°$ ] with Electronics Physics Multifunctional Transmission Line Design

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## ABSTRACT

Following High Temperature Superconductors (HTCSs) study series, Inverse Least Squares (ILS) 2D Numerical/Graphical Optimization is applied on Molecular Effect Model (MEM). Selected HTSCs class is Thallium group of [ Tl- Sn-Pb-Ba-Si-Mn-Mg-Cu-O ], constrained to [$T_C < 0°$ , $T_C > 0°$ ]. Tetragonal Lattice and Amorphous compounds of this Type II Thallium HTSCs are not included at this research stage. Solutions with Matlab 2D Graphical Optimization techniques to validate primarily the MEM sinusoid-shape analytical geometry are presented. Programming-methods and imaging processing comparisons with GNU-Octave and Freemat software are also shown. Results comprise 2D Tikhonov Regularization algorithms with mathematical methods for this class. Findings obtain acceptable Numerical and 2D Graphical Optimization outcomes with low error-residuals. Results show two parts, the 2D Graphical Optimization MEM modelling, and MEM comparative imaging processing systems with examples and analysis of several numerical equations and predictions. Applications of MEM for the overview of the Multifunctional Transmission Line for SCs and HTSCs are included. Electronics Physics usages for Superconducting Multifunctional Transmission Lines, Superconductors in general, and HTSCs are presented.

**Keywords :** Interior Optimization (IO) Methods, Graphical Optimization, Systems of Nonlinear Equations, Tikhonov Regularization (TR), Critical temperature [ Tc ], Inverse Least Squares (ILS), Electronics Superconductors (SC), High-Temperature Superconductors (HTSC), BCS Theory, [ Tl- Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] Molecular HTSC Group, Molecular Mass (MO), Molecular Effect Model (MEM), Superconducting Multifunctional Transmission Line (SCMTL).

## I. RESEARCH SERIES INTRODUCTION

Continuing the research series for Molecular Effect Modelling in HTSCs classes, [1,4-6, 42-45], 2D Graphical Optimization of the Thallium class [ Tl- Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] with [ $T_C < 0°$ , $T_C > 0°$ ]. This modern Type II HTSCs materials-class, has Critical Temperature $T_C$ magnitudes both over/under 0 ° Centigrade [1,2,4-6, 12-15, 32-34, 37, 42-45,46-48]. In superconducting effect, the critical magnitudes and their importance is described in [1, 4-6, 42-45,46-48]. Crucial critical physical magnitudes, are interconnected by a number of SC theory formulation [ 14-16, 26-29, 32-34, 44-48 ]. Superconducting theory begins from a Quantum Mechanics and Matter Structure basis. Its fundamental parameters are Critical Temperature, $T_C$ , Critical Current, J, and Critical Magnetic Field. MEM, at this stage, is related exclusively to $T_C$ and Molecular Mass (MO) variables [1, 4-6, 42-45].

This paper deals with the extension of numerical data for MEM model of HTSC Thallium class in range [ $T_C < 0°$ , $T_C > 0°$ ] . MEM 2D Graphical/Numerical Optimization for HTSCs [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] class is developed/compared with Matlab, GNU-Octave and Freemat systems. Amorphous Thallium compounds and Tetragonal Lattice compounds experimental database are not included at $T_C$ interval at this research stage. Specific GNU-Octave and Freemat programs were designed with imaging processing handle-based graphics, patterns, loops, and imaging processing subroutines.

Results comprise an imaging series with these three systems, comparisons among them, and numerical analysis/review of ILS MEM equations and $T_C$ predictions from [45].

*Grosso modo*, the article shows a Matlab, GNU-Octave and Freemat 2D Numerical-Graphical Optimization research for MEM in HTSCs [ Tl- Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] class. Further, it describes numerical analysis and predictions of MEM for HTSCs Thallium group. Numerical/graphical results show low residuals. The different computing systems used validate clearly MEM curves analytic geometry got in [43,44,45].

## II. MEM MATHEMATICAL ALGORITHMS AND EXPERIMENTAL DATA MATLAB GNU_OCTAVE AND FREEMAT

MEM computational method experimental database and programming algorithm corresponds to these series of Thallium HTSC approach [3,7,13,31,43,44,45]. It is presented in Tables 1, 2, [ 1, 4-6, 42-45, 46-48]. Here for GNU-Octave and Freemat the software is changed/modified specifically. Optimization algorithm is constructed with Tikhonov Regularization Theory [7,13,31,42,43,44,45] . Table 1 describes numerical experimental data for MEM [4-6, 12-15, 32-34, 37, 42-45] for $T_c > 0°$ Celsius Table 2 shows Numerical Experimental Data for MEM [4-6, 12-15, 32-34, 37, 42-45] for $T_c < 0°$ Celsius. Equation (2) indicates the research series algorithm.

**Table 1.-** Development data exclusively for [ $T_C > 0°$ ] optimization of parameters in 2D Graphical/Numerical-Algorithms MEM for HTSCs Thallium group. This experimental database was implemented in previous research with different critical temperature range [43-45].

| NUMERICAL OPTIMIZATION DATA [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] CLASS [HT-SUPERCONDUCTORS, [ Tc > 0° ] MOLECULAR EFFECT HYPOTHESIS] | |
|---|---|
| FORMULATION | MOLECULAR WEIGHT (UAM) / APPROXIMATE Tc (CENTIGRADES) |
| Tl7Sn2Ba2MnCu10O20 | 2.9531e+03 / 77 |
| Tl7Sn2Ba2TiCu10O20 | 2.9461e+03 / 65 |
| Tl6Sn2Ba2TiCu9O18 | 2.6462e+03 / 56 |
| Tl7Sn2Ba2SiCu10O20 | 2.9263e+03 / 53 |
| Tl6Ba4SiCu9O18 | 2.6636e+03 / 48 |
| Tl5Ba4SiCu8O16 | 2.4479e+03 / 44 |
| (Tl5Sn2)Ba2SiCu8O16 | 2.3264e+03 / 42 |
| (Tl5Pb2)Ba2SiCu8O16 | 2.5034e+03 / 38 |
| (Tl5Pb2)Ba2Si2.5Cu8.5O17 | 2.5933e+03 / 35 |
| (Tl5Pb2)Ba2Mg2.5Cu8.5O17 | 2.5839e+03 / 30 |
| (Tl5Pb2)Ba2Mg2Cu9O18 | 2.6195e+03 / 28 |
| (Tl5Pb2)Ba2MgCu10O20 | 2.6907e+03 / 18 |
| (Tl4Pb)Ba2MgCu8O13 | 2.0401e+03 / 3 |

**Table 2.-** Development data exclusively optimization for [ $T_C$ < 0° ] of parameters in 2D Graphical/Numerical-Algorithms MEM for HTSCs Thallium group. This experimental database was implemented in previous research with different critical temperature range [43-45].

| NUMERICAL OPTIMIZATION DATA [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] CLASS [HT-SUPERCONDUCTORS, [ Tc < 0° ] MOLECULAR EFFECT HYPOTHESIS] | |
|---|---|
| FORMULATION | MOLECULAR WEIGHT (UAM) / APPROXIMATE Tc (CENTIGRADES) |
| (Tl4Ba)Ba2MgCu8O13 | 1.9702e+003 / -8 |
| (Tl4Ba)Ba2Mg2Cu7O13 | 1.9309e+003 / -15 |
| (Tl4Ba)Ba2Ca2Cu7O13 | 1.9625e+003 / -19 |

Basic MEM formulas/algorithms from [1,4-6, 12-15, 32-34, 37, 42, 43, 44,45] are implemented in Matlab, GNU-Octave, and Freemat for this study. Equation (1) describes Inverse Tikhonov functional method like [42, 43, 44, 45]. The ILS Inverse Tikhonov algorithm MEM, with a polynomial p(MO) reads,

$$\begin{aligned}
&\text{minimize Tikhonov functional } J(\alpha),\\
&\text{with } \alpha 1 = 0 \text{ and } L_2 \text{ Norm,}\\
&J_\alpha(u)_{u\in\Re} = \left\| Au - p(MO) \right\|_2^2 + [\alpha 1]\, J(u);\\
&\text{Hence minimize,}\\
&\left\| T_{Ci} - p(MO_i) \right\|_2^2 \quad ,\\
&\text{for } i = 1,\ldots,n\\
&\text{subject to} \quad ,\\
&a \le MO_i \le a_1 \, ;\\
&b \le T_{Ci} \le b_1 \, ;
\end{aligned} \qquad (1)$$

where, as developed in [1, 4-6, 42, 43, 44,45], MO is HTSC molecular mass of the HTSC selected (i) within a HTSC group with (i) elements and [a-b] are numerical constraints interval vectors. $T_{Ci}$ is every critical temperature (Centigrade for MEM Thallium HTSCs class) for each (i) member of HTSCs class. The parameter α1 is a specific constant for Inverse Tikhonov Regularization. Constraints, related to $T_C$ and MO values from experimental data, are vector interval [a-b].

## III. RESULTS

2D MEM Graphical implementation with [$T_C$ < 0° , $T_C$ > 0° ] is shown in Figures 1,2,3. 2D fitting results get numerical/graphical solutions with acceptable residuals and confirmed steady sinusoid-shape of MEM in all Thallium class [43-45]. Comparative imaging processing in GNU-Octave and Freemat is presented in Figures 4,5. All images agree sharply to this HTSCs class that could have $T_C$ magnitudes higher and lower than 0 ° Centigrade. Time consuming for running program is about 5-10 seconds, depending on graphics subroutine/commands options and matrices size. GNU-Octave time is about 2-4 seconds longer, and Freemat 5-7 seconds much longer. Freemat handle-based graphics are different. Finally, a review with numerical analysis of examples from [45] is commented.

## 2D GRAPHICAL OPTIMIZATION RESULTS [$T_C < 0°$ , $T_C > 0°$ ]

In the following, series of images for Thallium class with [$T_C < 0°$ , $T_C > 0°$ ] numerical data implemented [43-45].

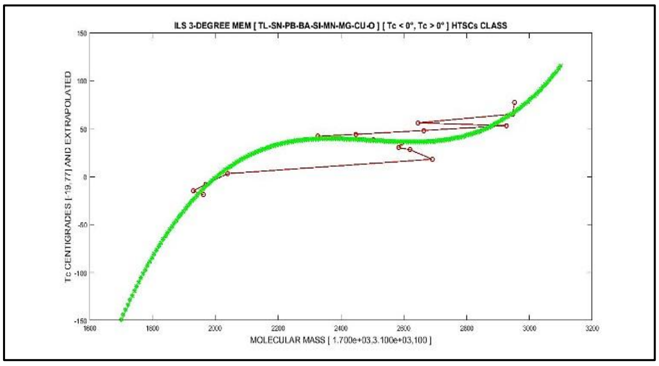



**Fig. 1.-** Matlab imaging processing with 3-Degree ILS MEM polynomial optimization for [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] HTSCs Thallium class, [$T_C < 0°$ , $T_C > 0°$ ] . Modelled curve (green) and experimental data (red). MEM results to confirm a sinusoid-like curve, just like in [43-45], approximately. Since this HTSCs class numerical data has a number of compounds with [ $T_C < 0°$ ] , MEM verifies that analytical geometry.

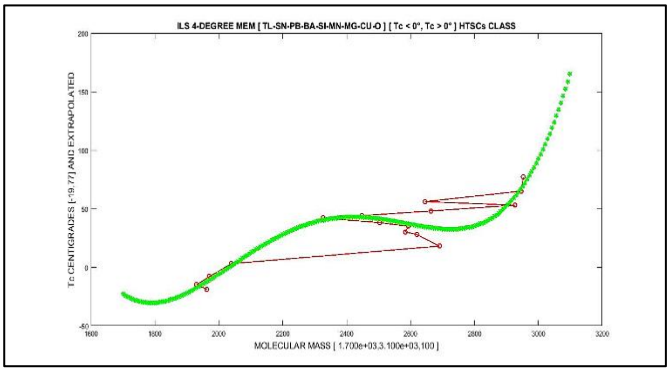



**Fig. 2.-** Matlab imaging processing with 4-Degree ILS MEM polynomial optimization for [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] HTSCs Thallium class, [$T_C < 0°$ , $T_C > 0°$ ] . Modelled curve (green) and experimental data (red). MEM results to confirm a sinusoid-like curve, like in [43-45], approximately. Since this HTSCs class numerical data has a number of compounds with [ $T_C < 0°$ ] , MEM verifies that analytical geometry.

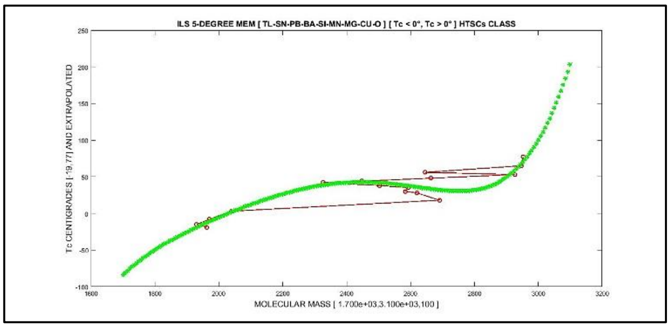



**Fig. 3.-** The most accurate approach although rather a large polynomial equation [43-45]. Matlab imaging processing with 5-Degree ILS MEM polynomial optimization for [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] HTSCs Thallium class, [$T_C < 0°$ , $T_C > 0°$ ] . Modelled curve (green) and experimental data (red). MEM results to confirm a sinusoid-like curve, just like in [43-45], approximately. Since this HTSCs class numerical data has a number of compounds with [ $T_C < 0°$ ], MEM verifies that analytical geometry.

## 2D GNU-OCTAVE AND FREEMAT GRAPHICAL OPTIMIZATION CONTRAST [$T_C < 0°$ , $T_C > 0°$ ]

GNU-Octave and Freemat imaging processing sotware corroborate the MEM sinusoid-like shape for extended Tc range, as it was shown in [43,44,45] with [$T_C < 0°$ , $T_C > 0°$ ] . Programming this images with GNU-Octave is easier than Freemat. Freemat has rather different handle-based graphics commands and subroutines. However, image quality, Figures, 4,5, is acceptable.

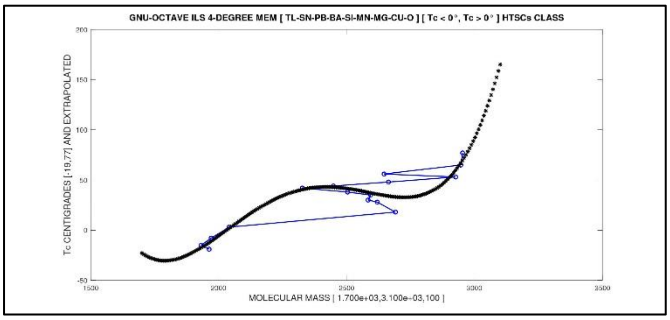



**Fig. 4.-** GNU-Octave MEM image with 4-Degree ILS MEM polynomial optimization for [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] HTSCs group. GNU-Octave MEM curve (black) and experimental data (blue). Imaging processing quality is acceptable like Matlab, but graphics tools are limited. MEM results of [43,44,45], are verified. Since this HTSCs class has a number of compounds with [ $T_C < 0°$ ], MEM validates that trend.

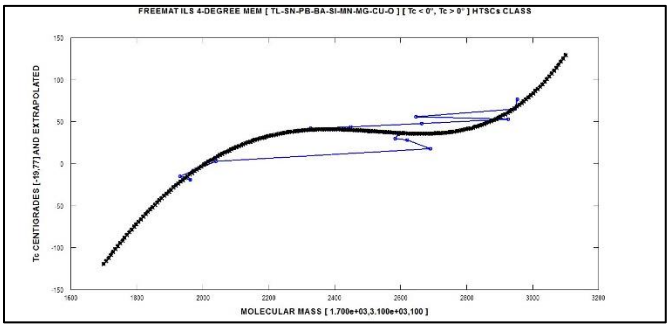



**Fig. 5.-** Freemat MEM image with 4-Degree ILS MEM polynomial optimization for [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] HTSCs group. Freemat program is different from GNU-Octave and Matlab, specially in plot subroutine settings. Freemat MEM curve (black) and experimental data (blue). Imaging processing quality is acceptable like Matlab, but graphics tools are limited. MEM results of [43,44,45], are verified. Since this HTSCs class has a number of compounds with [ $T_C < 0°$ ] , MEM validates that trend.

## 2D REVIEW OF MEM EQUATONS AND $T_C$ PREDICTIONS [$T_C < 0°$ , $T_C > 0°$ ]

From [44,45], a review of two numerical results with this MEM group is shown, Tables 3,4. At this MEM phase with [ $T_C < 0°$ , $T_C > 0°$ ] , predictions errors are rather high, about [ +/- 6 Centigrade ]. Residuals for equations calculations are acceptable [43,44,45].

**Table 3.-** From [45], a review of Matlab software 4-Degree ILS MEM polynomial equation Thallium HTSCs class [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] HTSCs group subject to [ $T_C < 0°$ , $T_C > 0°$ ]. 4th coefficient is discarded [ $\approx 10^{-12}$ ]. Residual magnitude is acceptable.

| ILS MEM (4-DEGREE) [$T_C < 0°$ , $T_C > 0°$ ] WITH APPROXIMATIONS | |
|---|---|
| COEFFICIENT | VARIABLE X SELECTED |
| 18.2941e+003 | CONSTANT |
| -33.2825 | X |
| 22.2890e-003 | $X^2$ |
| -6.5225e-006 | $X^3$ |
| ≈ 0 | $X^4$ |
| RESIDUAL = 5.8733 | |
| MODEL EQUATION | |
| $T_C$ = [ 18.2941e+003] +… … + [ -33.2825 ] MO + … … +[ 22.2890e-003 ] $MO^2$ +… …+ [ -6.5225e-006 ] $MO^3$ | |

**Table 5.-** From [45], 4-Degree ILS MEM Matlab Numerical Predictions, [MO Molecular Mass, $T_C$ Experimental, $T_C$ MEM Predicted, Error ( [ $T_C$ Experimental ] - [ $T_C$ Predicted ] ) ]. Error magnitude probably is caused by the nonlinear increase of Molecular Mass related to increment of $T_C$ [43,44,45].

**OPTIMIZATION PREDICTIONS Tc MEM ILS 4-DEGREE FOR [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ]**

| MO | Tcexperimental | TcPredicted | Error |
|---|---|---|---|
| 1962.4934 | -19 | -12.29724416104 | -6.70275583896 |
| 1930.9474 | -15 | -17.4814367218241 | 2.48143672182414 |
| 1970.1884 | -8 | -10.9672729743106 | 2.96727297431062 |
| 2040.0584 | 3 | 1.72313682971071 | 1.27686317028929 |
| 2690.7295 | 18 | 33.1603583123251 | -15.1603583123251 |
| 2619.4897 | 28 | 35.9129062684005 | -7.91290626840055 |
| 2583.8698 | 30 | 37.725694948087 | -7.72569494808704 |
| 2593.32105 | 35 | 37.2374662029069 | -2.23746620290694 |
| 2503.4204 | 38 | 41.467505094035 | -3.467505094035 |
| 2326.4404 | 42 | 40.5461494010051 | 1.4538505989949 |
| 2447.9369 | 44 | 42.9321709180404 | 1.06782908195964 |
| 2663.6085 | 48 | 33.9826050291704 | 14.0173949708296 |
| 2926.2966 | 53 | 59.8710061720994 | -6.87100617209944 |
| 2646.15 | 56 | 34.6788220733288 | 21.3211779266712 |
| 2946.0781 | 65 | 66.873193420648 | -1.87319342064802 |
| 2953.1491 | 77 | 69.634939187592 | 7.36506081240805 |

**Tc PREDICTED ERROR [Average Error 6.4939 ]**

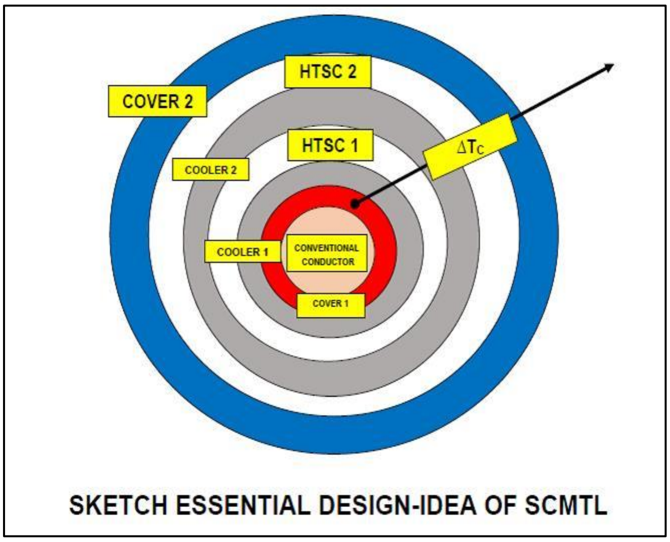
## IV. MULTIFUNCTIONAL TRANSMISSION LINE OVERVIEW [CASESNOVES, 2021]

A Superconducting Multifunctional Transmission Line [44, Casesnoves invention, 2021] is an electrical power line formed by a multiple superconductors stratums. This line has capability to transmit electrical power at a wide range of temperatures, depending on the engineering resources and power energy demand.

Nowadays, the energy demands and increased consumption has increased in recent decades [7]. This implies that the electrical power transmission losses constitute an industrial trouble both operational and economical. A possible method to sort out these difficulties could be the power loss transmission lines reduction by means of minimizing the electrical resistance. Superconductors materials would constitute a partial solution provided the engineering design/functionality could work properly and the sc-materials manufacturing/maintenance costs were moderate [43,44,45].

Sketch 1 shows the basic structure of a SCMTL [44, 46-48]. Its cylinder-shaped structure has several encircled layers of conducting and HTSCs materials. It could be designed as a coaxial line also. The innermost layer is formed by a conventional conductor. This could be used in a standard option power transmission if circumstances require that. The optional sc-materials distribution is as follows: from inner to outwards, stratums series of separated superconducting circular layers/covers are superposed. If necessary, cooling layers stratums are set among/between any subsequent types of superconductors or HTSCs. From inner to outwards, Sketch 1, the specific magnitude of $T_C$ is increasing. Therefore, the most external HTSC layer has the maximum $T_C$ magnitude. Depending on power engineering demands optimization, one or several superconducting layers can be used simultaneously for power transmission. Other option is the usage of the conventional inner conductor exclusively if physical-thermodynamical and/or environmental energy constraints compel that choice. Magnetic fields created by the superconductors and/or HTSCs layers while power conducting could be synergic also and increase the efficiency by modifying better the $T_C$ magnitude.

SCMTLs advantages could be a significant optimized save of electrical power with demands adaptation operational facilities [43,44,45]. Inconvenients are the higher manufacturing costs, more difficult/expensive repairs and maintenance, and cooling energy magnitude required.




**Sketch 1.-** Essential design of a SCMTL. HTSC1 , first superconductor type, HTSC2 the second one with higher $T_C$ . Direction of $T_C$ increase marked with arrow. Conventional conductor at center [45]. This is a simple idea-design.

## V. DISCUSSION AND CONCLUSIONS

The research objectives were to get a Matlab 2D Graphical/Numerical Optimization MEM for [ Tl-Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] HTSCs Thallium class with [ $T_C < 0°$ , $T_C > 0°$ ] centigrades $T_C$ interval. Additionally, to compare the imaging processing software with GNU-Octave and Freemat systems. Finally, a numerical analysis and review of equations and $T_C$ predictions was intended/shown [43,44,45]. All the software series of 2D graphs were designed to demonstrate the increasing correctness of the MEM fitness provided at [ $T_C < 0°$ , $T_C > 0°$ ] Centigrade.

The 2D Graphical and Numerical Optimization, Figures, 1,2,3, validate the analytic geometry MEM obtained in previous studies [43,44,45]. Programs done with imaging processing GNU-Octave and Freemat, Figures 4,5, validate the Matlab results of Figures 1,2,3. Imaging quality of GNU-Octave and Freemat is acceptable, but running times are longer than Matlab and imaging processing tools options are more minimal.

The SCMTL design was described with complementary primary Sketch 1. SCMTL operational functionality was explained with advantages and inconvenients rationalisations.

The numerical analysis and review of equations and predictions from [45] show errors of $T_C$ about [ +/- 6 ] Centigrades, rather high at this MEM design. However, the fitting residuals are considered acceptable. Probable reasons are the nonlinear distribution of $T_C$ related to molecular masses, and the short number of numerical database for the ILS 2D Numerical and Graphical Optimization.

In brief, Matlab imaging processing software for 2D Graphical and Numerical and Graphical Optimization for Thallium HTSCs [ Tl- Sn-Pb-Ba-Si-Mn-Mg-Cu-O ] class were studied along range [ $T_C < 0°$ , $T_C > 0°$ ] centigrade. Superconducting Multifunctional Transmission Line primary design was explained. Applications in Electronics Physics emerge from the 2D Numerical/Graphical analysis and software comparative results.

## VI. SCIENTIFIC ETHICS STANDARDS

IMPORTANT NOTE: In previous publication with Matlab, [43], a printing mistake in polynomial constant is the default of negative sign. The correct value is [ -8.2906e+03 ] , and NOT like in [43], [ +8.2906e+03 ]. Superconducting Multifunctional Transmission Line concepts and invention were created by Dr Casesnoves in 2021.

Equations 1,2 are the algorithms used in HTSCs series study [43,44,45], and cannot be written differently. Matlab, GNU-Octave and Freemat software is original from the author in all 2D/3D and Numerical

Optimizations results presented. 2D/3D Graphical Optimization Methods were created by Dr Francisco Casesnoves in 3rd November 2016, and Interior Optimization Methods in 2019. 2D/3D/4D Graphical and Interior Optimization Methods were created by Dr Francisco Casesnoves in 2020. This article has previous papers information, whose inclusion is essential to make the contribution understandable. The 2D/3D/4D Interior Optimization method is original from the author (August 2020-1). This study was carried out, and their contents are done according to the European Union Technology and Science Ethics. Reference, 'European Textbook on Ethics in Research'. European Commission, Directorate-General for Research. Unit L3. Governance and Ethics. European Research Area. Science and Society. EUR 24452 EN [38-41]. And based on 'The European Code of Conduct for Research Integrity'. Revised Edition. ALLEA. 2017. This research was completely done by the author, the computational-software, calculations, images, mathematical propositions and statements, reference citations, and text is original for the author. When a mathematical statement, proposition or theorem is presented, demonstration is always included. If any results inconsistency is found after publication, it is clarified in subsequent contributions. The article is exclusively scientific, without any commercial, institutional, academic, religious, religious-similar, non-scientific theories, personal opinions, political ideas, or economical influences. When anything is taken from a source, it is adequately recognized. Ideas and some text expressions/sentences from previous publications were emphasized due to a clarification aim [38-41].

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## VIII. AUTHOR'S BIOGRAPHY

Dr Francisco Casesnoves earned the Engineering and Natural Sciences PhD by Talllinn University of Technology (started thesis in 2016, thesis Defence/PhD earned in December 2018, official graduate Diploma 2019). Dr Casesnoves is European Union and Internationally qualified as Doctor in Engineering to supervise PhD Theses, Master Theses, and Bachelor Theses in science and engineering. He works as independent research scientist in computational-engineering/physics. Dr Casesnoves earned MSc-BSc, Physics/Applied-Mathematics (Public Eastern-Finland-University, MSc Thesis in Radiotherapy Treatment Planning Optimization, which was developed after graduation in a series of Radiation Therapy Optimization-Modelling publications [2007-present] ). Dr Casesnoves earned Graduate-with-MPhil, in Medicine and Surgery [1983] (Madrid University Medicine School, MPhil in Radioprotection Low Energies Dosimetry [1985]). He studied always in public-educational institutions, was football player 1972-78 (defender and midfielder) and as Physician, supports healthy life and all sports activities. Casesnoves resigned definitely to his original nationality in 2020 for ideological reasons, democratic-republican ideology, ethical-professional reasons, anti-state monarchy corruption positions, and does not belong to Spain Kingdom anymore. His constant service to the International Scientific Community and Estonian technological progress (2016-present) commenced in 1985 with publications in Medical Physics, with further specialization in optimization methods in 1997 at Finland—at the moment approximately 100 recognized publications with approximately 65 DOI papers. His main branch is Computational-mathematical Nonlinear/Inverse Methods Optimization. Casesnoves best-achievements are the Numerical Reuleaux Method in dynamics and nonlinear-optimization [books 2019-2020], The series of Radiotherapy Improvements for AAA superposition-convolution model, the Graphical and Interior Optimization Methods [2016-8], the new Computational Dissection-Anatomical Method, [2020], invention of Forensic Robotics [2020-2021], and Molecular Effect Model for High Temperature Superconductors [2020]. Dr Casesnoves PhD thesis is an Estonian scientific service to European Social Fund and several EU Research Projects. Dr Casesnoves scientific service since 2016 to the Free and Independent Republic of Estonia for technological development (and also at Riga technical University, Power Electrical and Electronics Department) is about 40 physics-engineering articles, two books series, and 1 industrial radiotherapy project associated to Europe Union EIT Health Program (Tartu University, 2017).

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